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THE CONTRIBUTION OF TECHNOLOGIES, INCLUDING NEW AND EMERGING ONES, FOR THE INDUSTRIALIZATION OF DEVELOPING COUNTRIES AND FOR THE STRENGTHENING OF REGIONAL AND GLOBAL INTEGRATION PROCESSES, INCLUDING PROPOSALS ON WAYS AND MEANS OF TRANSFERRING SUCH TECHNOLOGIES AND FOR THE INCORPORATION IN THE PRODUCTIVE SECTOR OF THOSE COUNTRIES

Contribution of technology to industrialization and regional and global integration

Report of the Secretary-General

SUMMARY

In pursuance of the request to the Secretary-General by the former Intergovernmental Committee on Science and Technology for Development and the Economic and Social Council, this report reviews the impact of global technological and managerial transformations on the economies of the developing countries and the extent to which regional and global economic integration can contribute to those countries' technological modernization and improved international economic performance.

The report emphasizes the need to integrate science and technology policies in developing countries in order to ensure the upgrading of their scientific and technological base and strengthen the linkages between national research and development and private firms. It underscores the new conditions for innovation-driven regional economic integration that have resulted from the globalization of research and development and inter-firm collaborative agreements.

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INTRODUCTION

1. In its resolution 1(XI)B of 3 May 1991, the former Intergovernmental Committee on Science and Technology for Development requested the Secretary-General, drawing upon the work of the relevant organs, organizations and bodies of the United Nations system, to present a report to the Intergovernmental Committee at its twelfth session on the contribution of technologies, including new and emerging ones, for the industrialization of developing countries and for the strengthening of regional and global integration processes, including proposals on ways and means of transferring such technologies and for their incorporation in the productive sector of those countries.

2. The present report has been prepared in pursuance of that request. In addressing the theme, consideration has been given to General Assembly resolution 46/145 of 17 December 1991, in which the Assembly emphasized the importance of activities promoting regional economic integration among developing countries. In particular, the General Assembly recognized the need to support, inter alia, the preparation of studies and implementation of measures to facilitate trade, as well as the harmonization of the macroeconomic policies and legal systems of the countries concerned; and to explore the technological aspects of such industrial reconversion processes as might be economically necessary during the process of integration.

3. The report also takes into account the spirit of General Assembly resolution 46/165 of 19 December 1991, in which the Assembly stressed the importance of national capacity-building for the transfer and adaptation of technology for development and requested the Commission on Science and Technology for Development to submit to the General Assembly at its forty-eighth session concrete proposals for organizing a more effective coalition of resources to meet the scientific and technological needs of developing countries.

4. In addition, the General Assembly, at its forty-seventh session, pursued the discussions on industrial development cooperation and the diversification and modernization of productive activities of developing countries and adopted resolution 47/173 of 22 December 1991, in which it stressed the importance of international cooperation in supporting efforts at the regional, subregional and national levels in industrial development, particularly in the fields of human resources development, investment and export promotion, technology transfer, industrial conversion and development of national capacities, in order to diversify and modernize productive activities in developing countries.

I. BACKGROUND

5. The past 10 years have been characterized by a wide diffusion of new technologies in the areas of micro-electronics, communications, informatics, genetics and materials science which, together with new concepts and processes of management, are completely altering the production of goods and services, encompassing what has been termed a technical and managerial revolution. As a result, important changes have occurred in the structural and educational requirements of the labour force, in the composition and the dynamics of

international trade and capital movements, and in the patterns of international competition. Furthermore, these new and emerging technologies are producing changes in the nature, financial requirements and speed of the process of innovation itself.

6. There has been a growing consensus among development institutions that technological change cannot be separated from a much wider process of social change. The process of innovation or technological change is perceived as an endogenous and cumulative process; endogenous, because the produced technological change is continuously being selected and adapted to the broad needs and requirements of society, and cumulative, because a network of micro-economic relationships establishes effective links between technology creation, technology learning, economic growth and technology accumulation. 1/

7. Attention should be drawn to the fact that, in spite of the pervasive nature of the new technological wave and of the micro-economic rationality of the techno-managerial revolution, the new elements of production and finance have not been converted into stable and constant growth scenarios. In other words, the techno-organizational changes have not yet provided the key conditions for sustainable growth: stable exchange rates, growing opportunities for employment and predictable and consistent rules for world trade.

8. Developing countries are paying a high price for adjusting their economies to these major changes in the international economy. The majority of developing countries have adopted stringent macroeconomic policies to solve fiscal problems, price instability and foreign debt-servicing. As a result, these countries are experiencing difficulties in the upgrading of their technological capabilities, largely due to a dramatic reduction in social expenditures, which has adversely affected their basic educational and research infrastructure.

II. GLOBALIZATION AND TECHNOLOGY: MAJOR TRENDS

9. Historically, technological innovations in areas such as energy, transportation and communications have led to changes in the international location of production and consequently in the patterns of international specialization. The internationalization of goods and services production reached a further stage with the current process of globalization of business and of growing interdependencies among markets, with foreign direct investment as the driving force and transnational corporations as the main instrument. The global reach of international enterprises and the networking of their information systems, which was characteristic of a few industries at the beginning of this century, has become widespread with the application of new information and communications technologies.

10. The greater speed in the transformation of earlier patterns of internationalization has been seen as the result of two interrelated and widespread changes: (a) changes in the institutional and regulatory conditions in money and capital markets with the creation of global financial markets and the globalization of the enterprise structure itself; and (b) the growth of new technologies in the areas of micro-electronics, communications, informatics and materials science. These technologies, in particular, information and communications (telematics) technologies, have facilitated the globalization

process while simultaneously providing further impetus to the process. 2/ This process of globalization has been uneven and has not reached the same levels over all industries and markets.

11. Of these two changes, it is the pervasive nature of advances in micro-electronics, including those in computers and telecommunications, that has been more often associated with the current wave of technological expansion. Overall applications of information technology have totally transformed a diversified array of activities, including finance, banking, business management and public administration, thus enabling the automation of telecommunications and linkages with computers by data transmission. The evolution of information technologies is reflected in significant improvements in performance accompanied by impressive reductions in cost over recent decades, thereby inducing further expansion of micro-electronics and informatics. 3/

12. The implications of globalization for the international system are not yet fully understood. The evidence so far is limited and contradictory. Financial globalization associated with new forms of corporate organization, particularly in research and development-intensive and scale-intensive manufacturing and service industries, has determined higher levels of market concentration. World competition has established world oligopoly as the dominant structure of world markets. Computer, communications and control technologies are permitting transnational corporations to link together production, marketing and research and development facilities on a world-wide scale. Nevertheless, the same technologies are simultaneously permitting greater flexibility and decentralization of operations and market segmentation, thereby providing room for small-sized firms and small economies, albeit in a different context of supplier-client relations. Moreover, the application of these new technologies has allowed small- and medium-sized enterprises themselves to undertake multinational operations.

13. Furthermore, although research and development facilities are still located near corporate headquarters, telematic networks offer opportunities for the internationalization of research and development and for the international sourcing of technological resources through inter-firm cooperation agreements. Most (but not all) of these non-market coordination mechanisms may act as barriers to technology transfer. Inter-firm collaboration in research and development reverses a long tradition of direct appropriation of knowledge through in-house research and development and centralization of these activities in the parent corporation.

14. Developing countries are not necessarily excluded from these knowledge-intensive flows, as has been demonstrated by the successful efforts of many Asian and some Latin American countries. Nevertheless, the emergence of a "virtuous" cycle between the use, growth and accumulation of technology will depend on the ability of a country's institutions to establish the necessary linkages between research institutions and domestic firms, as well as to induce private enterprises to undertake research and development activities. In order to succeed in the global economic environment of the 1990s and move away from non-growth or slow-growth areas, most of the developing countries will need to enforce domestic policies for endogenous capacity-building, with the support of the international community. 4/

A. Globalization and the development process

15. Traditionally, developing countries have been importers of technology. Their prospects for technological transfer, technological development and economic growth in the near future depend not only on domestic but also on the external determinants of capital and technology flows. A review of trends in technology flows in the second half of the 1980s by the United Nations Conference on Trade and Development (UNCTAD) revealed continued growth in the relative importance of capital goods trade and foreign direct investment among developed countries, an acceleration of such flows to a small number of Asian developing countries and only modest improvement (compared with the first half of the decade in their rate of growth in real terms) to the majority of developing countries. 5/ Hence, fears that developing countries may be left at the margin of the current process of technology intensification appear to be substantiated.

16. An important characteristic of the process of technology creation and technology use is its self-reinforcing nature. The process of technological capacity-building offers increasing returns and feeds upon itself, providing further opportunities for technology use, growth and accumulation. The path-dependent character of the innovation process reflects the importance of acquired learning and experience for the building of further learning and experience or, in other words, the dependence of the innovation process on the historical process of technology creation and accumulation. 6/

17. Technology, in economic terms, incorporates the design and production of goods and services, including the various modalities of organizing such production in individual firms and between firms. Technology is embodied in machines, parts and equipment, as well as in human abilities to use existing hardware and to improve it. Technology alone cannot ensure economic prosperity for a nation; for that it is necessary to formulate a set of regulatory and institutional arrangements that will foster the transfer of technological capabilities between and within firms and sectors. The interaction and feedback between social institutions and technologies reflect the cumulative nature of the process of technological change. Technical, economic and social change are inseparable and interdependent components of the same process: the innovation process, the interactive process of technology creation, market experimentation, technology learning and diffusion.

18. The endogenous and cumulative features of the innovation process imply that market forces per se are unlikely to lead a society to higher levels of endogenous scientific and technological capability. On the contrary, given the path-dependent character of technological development, any given situation in time is dependent on the previous one. Unless effective links between domestic private and public institutions and national systems of science and technology have been established, market forces will simply tend to reinforce the existing situation and will not lead a society away from a stagnating or slow-growth position.

19. The spread of innovations in biotechnology and the growth and use of new materials and information technology present both challenges and opportunities for developing countries. A crucial element is the capacity of a country to absorb these new technologies through its industrial, scientific and

technological base as well as though its institutions. Inter-country differences in domestic scientific and technological capabilities and attractiveness to foreign capital and technology suggest therefore that disparities between developing and developed countries as well as among developing countries themselves will tend to increase.

20. Over the past four decades, developing countries have carried out extensive programmes of industrialization that have exhibited various levels of efficiency and incorporation of technical progress. In the majority of developing countries, successful industrialization has resulted in regional and social inequalities and negative environmental effects. Some countries have become competitive exporters of manufactured goods based on abundant natural resources and cheap labour but have not made substantial investments in human resources training and research and development facilities.

21. The diversity of development experience among developing countries permits a better understanding of the forces behind successful industrialization strategies. Several studies undertaken under the auspices of the United Nations have stressed the importance of domestic scientific and technological capabilities and institutions as well as of selective policy instruments. 7/ The analysis of the industrial transformation and of technological and trade performance of the advanced economies of East Asia and of some Latin American countries have further substantiated the strategic role of domestic policies. 8/

22. Recent literature on technological innovation has called attention to the complex combination of private appropriation and public goods aspects involved in the process. It has been remarked that much of the knowledge required to acquire a new technology system, in its early phase, is public knowledge, available in universities. 9/ The current wave of technological transformation has opened opportunities for technological leapfrogging in some areas but is constrained by the limitations of domestic scientific expertise and domestic techno-industrial structure. However, in technologically advanced industries with a high research and development content (for example, pharmaceuticals, chemicals and semiconductors), with concentrated supply structures and greater enforcement of intellectual property rights protection, as well as intensified international technological competition and growing research and development costs, it is extremely difficult for developing countries' firms to acquire new technologies and penetrate these markets.

23. Numerous United Nations documents have underscored the relevance of technological progress for developing countries in the areas of biotechnology, materials and micro-electronics. 10/ Some developing countries possess the necessary skilled scientific and technical personnel to enable the use of sophisticated hardware and scientific knowledge, including, for example, the capacity to apply biotechnology to food and agricultural production, the production of renewable energy, waste recycling, pollution control and medical treatment. For such countries it is crucial to ensure access to the knowledge and hardware produced in developed countries and to build up appropriate linkages between national systems of science and technology and private enterprises. In the near future, countries deprived of skilled human resources and capital will have difficulty competing with new commodity-substituting engineered products in world markets. A similar difficulty may arise from the

creation by industrialized countries of highly engineered materials, such as advanced ceramics, plastics and metallic alloys, composites and superconductors, a development which could undermine the comparative advantage of resource-based exports of developing countries.

B. Globalization and world trade

1. Major changes in the composition and dynamics of world trade

24. Information technology has determined fundamental structural, technological and organizational transformations in most of the industries in developed countries. The key features of these transformations are great product diversity, high productivity and flexibility, due to the development and diffusion of a family of automation technologies, including flexible manufacturing techniques and new products derived from micro-electronics-based control and communications systems. Concerns exist that these transformations will undermine the comparative advantage of those commodity-exporting developing countries that have abundant natural resources and cheap labour.

25. Studies conducted by UNCTAD show that the effect of these changes on the global comparative advantage of developing countries could lead to a shift of production location to the industrialized countries but that this has not yet been reflected in current trade data. In spite of adverse technological change, some developing countries have been able to maintain the competitiveness of their exports. An analysis by the Economic Commission for Latin America and the Caribbean (ECLAC) of countries that increased their share in industrial countries' imports revealed that some of the developing countries in the sample (China, the Dominican Republic, Mexico, the Republic of Korea, Singapore and Thailand) had a predominance of non-traditional manufactured products, which were over two and a half times their exports of natural resources, including petroleum. Another group of developing countries (Brazil, Chile, Costa Rica and Uruguay) was able to increase its share in industrial countries' markets through improved efficiency in the production of mainly traditional lines of goods. 11/

26. Hence, it should be emphasized that attempts to interpret the overall effect of new technologies on trade patterns and international competitiveness remain speculative and should be viewed with reservation.

27. However, a few trends concerning the effect of technological change on production and trade can be asserted. First, the declining raw-material intensity of finished products as a result of resource-saving and an increase in knowledge-intensive innovations, materials substitution, reduced wastage and new and improved methods of processing have contributed to the slower growth or even decline in the international trade of raw materials, including most ores and metals. Secondly, technological change has also influenced the pattern of international trade in manufactured goods. Over the past decade, the most dynamic products have come from highly research-and-development-intensive industries. 12/ The global share of technology-intensive exports increased from 21.5 to 28.6 per cent between 1978 and 1988. 13/

28. Moreover, the most dynamic segments of world trade are intra-industry, meaning those trade flows comprised of goods that are part of the same industry. In addition, capital, goods, technology and services are predominantly traded among industrialized countries. Developed economies accounted for more than 80 per cent of world-wide foreign direct investment inflows in 1990 14/ and for more than 70 per cent of the value of world exports. A large part of these trade flows are also intra-firm; in other words, goods and services are exchanged among different components of the same transnational group.

29. Intra-firm trade is associated with concentrated supply structures but it has also resulted from the activities of transnational corporations, strategies of offshore production and out-sourcing, which have benefited labour-intensive manufactured exports from developing countries. Reductions in the costs of transportation and particularly of information have made possible the shipment of semi-manufactured goods between production sites. For example, stores in the United States of America buy plastic toys from Hong Kong produced in China, based on raw materials shipped from Malaysia; also, integrated chips are fabricated and etched in the United States, assembled in Mexico and re-exported to the United States for final sale. 15/

30. Some developing countries have been able to move out of slow-growing resource-based exports into existing items with a higher value added. Such countries have been able to make the transition and become exporters of technology-intensive manufactured goods. Malaysia, for example, exported technology-intensive goods valued at only $3 million in 1968, but by 1988 that figure had increased to $1.4 billion (at 1968 constant prices). Five developing countries (Brazil, China, Malaysia, Mexico and the Republic of Korea) accounted for 0.8 per cent of world exports of technology-intensive products in 1968 and for 7.2 per cent in 1988. 16/

31. Also, firms in a number of developing countries have succeeded in upgrading skills and technologies and are therefore able to sustain their competitiveness in traditional products. Differences in the level and accumulation of technological capabilities, as well as related organizational and marketing skills, are among the factors that have determined the extent to which countries, especially developing countries, have been improving their trade and growth performance. In such countries as Brazil, China, Colombia, Indonesia, Malaysia and Thailand, and the newly industrializing countries and areas of East Asia, including Taiwan Province of China, firms have demonstrated an ability to rationalize production methods, raise product quality and reduce production costs in medium and low research-and-development-intensive industries. Examples include the development and application of indigenous engineering and design capabilities, and the access of machinery, components and other inputs from foreign suppliers in the higher research-and-development-intensive industries.

2. Major changes in the regulation of world trade: globalization and national policies

32. The rules of the international trading system as summarized in the General Agreement of Tariffs and Trade (GATT) viewed free trade as the ultimate objective and tariffs as the basic instrument of trade policies. Over the first three decades after the Second World War, GATT contributed to the expansion of

world trade, mostly in manufactured goods, by restricting the ability of contracting parties to close off their domestic markets and limit international exchange in response to domestic and international crises.

33. A wide variety of documents prepared by United Nations agencies have drawn attention to trade measures in the developed countries that aim to protect their industries, as well as to their promotion or protection of domestic technology. The globalization of financial markets and corporate structures, combined with the increasingly high proportion of the world output traded among nations, have created new pressures for government intervention to protect a nation's economic well-being; however, the same forces have the potential to constrain such intervention.

34. The globalization of markets, the international convergence of technological capabilities among industrial economies and the growing importance of transnational corporations have created an environment in which relatively small institutional differences and shifts in relative competitiveness can have large effects on international trade and investment flows. Moreover, the industrial development experience in the years since the Second World War, particularly that of Japan and the East Asian economies, has underscored the crucial role of trade and investment policies in the creation of competitive advantage and the allocation of global resources.

35. The globalization of the world economy and competitive forces at the national level have led to pressures for the establishment of new rules in the critical areas of intellectual property rights, foreign investment and services, as well as for the limitation of the use of general policy instruments that could lead to trade distortion effects. These issues were taken up in the Uruguay Round of trade negotiations, launched in 1986 and still in progress.

36. The conclusion of the Uruguay Round would provide a general agreement on trade and services in which the contracting parties would accept, inter alia, uniform and stricter standards of intellectual property rights enforcement, restriction of performance requirements on transnational corporations and the opening up of services sectors. These new regulations could severely affect the prospects for technological and economic development of developing countries and considerably limit their adoption of policy options for promoting the dynamism of their industrial and services sectors.

3. The role of research and development, technology transfer and services for international competitiveness

37. Technological innovation in developed countries and the transfer of technology to developing countries both play a critical role in determining the pattern of world trade and changes in that pattern over time.

38. Technology transfer is a long and expensive process which goes beyond the establishment in a developing country of a plant that uses the latest available technology. Local workers and engineers must be able to understand enough of the technology to deal with all production and maintenance difficulties. The basic theoretical knowledge used in the plant's processes must be fully mastered and that knowledge incorporated into university engineering courses so that it

can be locally reproduced. For technology transfer to be completed, a country must make the necessary infrastructural and institutional changes over a long period, so that an intensive and fruitful learning process can take place in both new and older technologies. Developing countries must undertake infrastructural investment in education, training, research and development and other scientific and technical activities, that is, they must undertake endogenous science and technology capacity-building, if they are to fully realize the benefits of the acquisition of imported technologies.

39. Furthermore, the sustained competitiveness of a country depends on a wide array of capabilities. The ability of a country's firms to generate innovation does not preclude other competitors from bringing to the market improved variations on a new product. The full success of an innovation-driven enterprise depends not only on its lead in commercial markets but on its ability to embody other complementary technological and non-technological assets, such as manufacturing capability and marketing and after-sales services. Countries should be aware that national systems of science and technology must be linked to domestic systems of production and distribution: it is the networking of information and innovation that drives the positive reinforcing dynamics of the economy.

C. Globalization and corporate strategies

40. Enterprises play a central role in the innovation process, since they constitute the basic institution responsible for bringing new technologies to the market in the form of new products or new production processes. The practices adopted by large corporations, as well as their new organizational and managerial structures, will affect both their relations with domestic and international suppliers and the generation and diffusion of technology. Hence, the strategies of large suppliers have a bearing on international location of production and consequently on the dynamics, direction and composition of capital and trade flows.

41. The modern corporation may be seen as a solution to the organizational problems created by the expansion of mass production technology. Mass production requires large investments in sophisticated equipment and highly specialized workers. But the nature of mass production makes it profitable only in markets that can absorb a large volume of a single, standardized commodity or that are stable enough to sustain full employment of the resources committed to the production of that particular commodity.

42. The spread micro-electronics and new management principles that concentrated on quality improvements, control of inventories and higher participation of the labour force made a reversal in mass-production practices possible. This trend is evident in the spatial transformation of old mass-producing industrial plants, as well as in new industries. It has been fostered through the use of flexible equipment by a smaller and less specialized (but more skilled) labour force and in a wide variety of sectors such as capital goods, textiles and apparel. The production capacity of both new and reorganized industries can accommodate customized orders as well as large operations, and deliveries can be programmed to adjust to inventory-saving methods such as "just-in-time delivery".

43. The new system, derived from newly adopted management principles and new technologies (computer-aided techniques and telematics), has a dual dimension. It offers the potential for quasi-integration of corporate operations world wide but also makes greater use of external suppliers to provide many functions, services and products formerly produced within the firm. A greater demand is placed on the suppliers and they also become responsible for many aspects of component and subassembly development, design, production and delivery that were previously defined by the client corporation. These changes in user-producer relationships between firms have affected research and development and product development. For instance, a Brazilian firm, having designed and developed an articulated piston for an American company, in order to satisfy the production requirements of the client had to invest in the construction of a plant in the United States of America. In the 1970s, such a client would have provided a complete specification of the product design. 17/

44. In the past, difficulties in ensuring adequate supervision and control of research and development activities restricted the spread of research and development activities among the components of the transnational corporations group. Despite the fact that transnational corporations prevailed in the most dynamic industrial sectors of developing countries (chemicals, pharmaceuticals, transport equipment and consumer durables, for example), those activities were concentrated within the parent corporation, with practically no research and development activity located in developing countries. The new technologies of information and communication have increased the scope for internationalization of research and development by transnational corporations, although the type of research and development carried out and the extent of its internationalization differs among industries. For instance, the pharmaceutical industry displays one of the most highly internationalized patterns of corporate research and development. 18/ The extent to which firms internationalize their technology-related activities would therefore appear to depend to a large degree on both the technical requirements of the industry and the scientific endowments of countries and affiliates.

45. This globalization of technology-related activities is rapidly affecting the location and organization of innovation; but the effects and implications of globalization on national systems of innovation and on the opportunities and limitations for technology access and transfer cannot yet be ascertained. A recent trend in corporate strategy that has a bearing on the process of technological innovation is the increase in the number of technology-related strategic alliances, inter-firm agreements and network relationships. Inter-firm technology cooperation agreements involve knowledge-production or the sharing of these activities between independent firms. Past research on transnational corporations' strategies has shown that collaborative research and development in foreign joint-venture subsidiaries was rare throughout much of the 1970s.

46. These strategic alliances differ from previous forms of inter-firm agreements, such as joint ventures, subcontracting or licensing agreements, basically because the current modalities of association which bind firms together (a) are more flexible and range from single-project to several forms of non-equity agreements; (b) deal with the dynamics of innovation and competition; and (c) are strategic in the sense that they affect long-term planning objectives. The new forms of agreements provide firms that are facing financial

and economic uncertainty in the world economy with the means to ensure a high degree of flexibility in their operations. The inter-firm agreements have flexible and risk-sharing characteristics that are particularly appealing to firms moving in markets of rapid technological change. Partners in strategic alliances may come from the private or public sectors.

47. In some cases, inter-firm agreements and alliances are instruments of corporate competition strategy and may create implicit protection of key technologies through cooperation among a few enterprises. For instance, research carried out on the partnering activity of 12 European information technology enterprises showed that a European technology-based oligopoly was evolving. 19/ The driving force of these strategic alliances is the tendency of new generic technologies to modify, blur and eventually break down previously well-established boundaries between industries. Therefore, barriers to entry in these industries, to be effective, will have to be built round clusters of technology-related industrial and service activities rather than closely defined industries or product groups. 20/

48. Recent research on international technology agreements during the 1980s showed that the newly industrializing countries and areas of East Asia, including Taiwan Province of China, figured prominently in that period's upsurge of international technology networking. 21/ There are reasons for believing that developing countries may benefit from this movement towards information and innovation networking, particularly through the use of regional mechanisms. Developing countries cannot afford to remain isolated from either these global trends in research and development or the global strategies of transnational corporations.

III. REGIONALIZATION IN THE CONTEXT OF THE GLOBAL DIFFUSION OF THE NEW TECHNOLOGIES: NEW ISSUES

49. The globalization of the international economy is being accompanied by a general tendency to build regional economic and trading blocs. The growth of regionalism is a defining feature of contemporary international economic relations. Although, at first glance, regionalization and globalization appear as contradictory tendencies, in reality they are consistent with one another. Two features are common to both: first, foreign direct investment acts as the driving force; and second, intraregional trade flows are basically of an intra-industry nature. 22/

50. The completion of a single European market became a reality at the beginning of 1993 and has transformed the European Community (EC) into a true common market within which goods, services and factors of production are able to move freely. Another major programme that reinforces regionalization is the European Economic Area, which establishes closer links between the countries of the European Free Trade Association and EC members. The increasing network of agreements between the EC and the remaining European countries suggests the emergence of an essentially integrated market covering most of Europe during the 1990s.

51. Formal and informal trading and investment regions have also been promoted over the past few years, linking developed and developing countries. The most

recent example is the North American Free Trade Agreement, comprising the United States, Canada and Mexico, which succeeded the 1988 United States-Canada Free Trade Agreement. Similarly, investment in Asia by Japanese transnational corporations through regional core-network strategies has forged an investment-oriented Asian integrated area.

52. Initiatives aimed at economic integration among developing countries have also multiplied in recent years; however, these attempts have not been driven by the same motivations as those in the developed countries. In Latin America, members of existing agreements, such as the Central American Common Market, the Latin American Integration Association, and its subgroup the Andean Group, have renewed their efforts to implement free trade areas and other modalities of regional and subregional trade liberalization measures. In South America, Argentina, Brazil, Paraguay and Uruguay have agreed to set up a common market, the proposed Southern Cone Common Market (MERCOSUR), which is in the process of implementing a common external tariff. In the Caribbean area, the Caribbean Community is working on phasing in a common external tariff, while in Africa members of the Organization of African Unity signed a treaty in June 1991 proposing the gradual establishment of an African Economic Community.

53. In Asia and the Pacific, a number of new regional initiatives are under way. In January 1992 members of the Association of South-East Asian Nations (ASEAN) agreed to create a free trade area, to be completed within a 15-year period. Plans have also been announced for a trading zone in north-east Asia. In addition, the heads of 11 Governments met in Istanbul at the end of June 1992 to initiate a Black Sea zone of economic cooperation.

54. The late 1980s and early 1990s witnessed the growth of networking in research and development among firms and research institutes within and across developing regions, the adoption of policies to promote human resource development in the Southern African Development Community (formerly the Southern African Development Coordination Conference) and various modalities of regional and subregional cooperation, which reflected the impact of changes in the competitive strategies of transnational corporations and new development strategies in developing countries implemented since the 1980s.

A. The European experience

55. The European Community is the most highly developed regional arrangement in the international system. It has evolved considerably since the Treaty of Rome was first signed in 1957. From a customs union with six members, it has been transformed into a fully functioning single market with 12 members sharing common micro-economic and macroeconomic policies. European integration has resulted in a significant increase in intra-EC trade flows over and above what would have occurred in its absence. Following the Treaty of Rome, the share of intra-EC exports in total EC exports increased steadily, rising from less than 40 per cent in 1958 to 60 per cent in 1990. 23/

56. One of the most distinctive features of intra-EC trade has been the growth of intra-industry trade. Hence, regional trade liberalization led to specialization within industries rather than movements of resources between industries. Intra-industry flows make up approximately two thirds of European

intraregional trade, consisting primarily of intermediate goods (50 per cent) and capital goods (26 per cent). 24/

57. The EC has launched a series of European research and development initiatives since the early 1980s aimed at decreasing the technology gap between Europe and its two main trading partners, the United States of America and Japan. Existing EC research and development programmes, launched in the early 1980s, have several goals: (a) to ensure that Europe has a domestically generated expertise in major technologies, particularly generic ones such as clean manufacturing techniques and those which are applicable in many different industries; (b) to enable European companies to reap economies of scale in research and development; (c) to spread ideas across national frontiers and promote exchange among scientists; (d) to coordinate national research and development programmes and avoid duplication of effort; (e) to finance research and development programmes which no single Government alone could afford, such as the Joint European Torus, a nuclear fusion programme; and (f) to narrow technological gaps within the EC. 25/

58. Among the most important of the above-mentioned EC initiatives are the European Strategic Programme for Research and Development in Information Technology and Telecommunications (ESPRIT), the research and development programme in advanced communication technology for Europe, the programme to promote the application of modern technologies to traditional industries and the Biotechnology Action Programme. In addition, the European Research Cooperation Agency (EUREKA), an independent research programme, includes another seven non-EC European countries to which the EC contributes. 26/

59. The ESPRIT programme was established in February 1984 by member States of the EC as a 10-year project (two five-year phases) to promote the competitiveness of European industry; it was inspired by the Japanese experience with inter-firm research consortia. Initially, the 12 largest information technology firms were invited to draw up a work programme for their industry. The resulting programme aimed at (a) the promotion of intra-European industrial cooperation in research and development in five main information technology areas (advanced micro-electronics, software technology, advanced information processing, office systems and computer integrated manufacture); (b) the provision of the basic technologies that European industry needs to foster its competitiveness through the 1990s; and (c) the development of European standards. By 1992, a total of 561 such projects were under way or had been completed. Nearly 800 firms and 500 research laboratories in universities and research institutes across the EC took part in the ESPRIT programme. In 1992, for example, ESPRIT claimed credit for more than 700 information-technology prototypes, tools or standards. 27/

60. EUREKA was initiated by France in 1985. As with ESPRIT, its objective is to encourage cross-border collaborative civilian projects between firms and research institutes from different EUREKA member countries, irrespective of size and structure, as a means of strengthening the competitiveness of European industry. Within six years EUREKA had 500 ongoing projects. Unlike ESPRIT, EUREKA has no preselected themes to which prospective consortia must limit themselves. Instead, participants have full responsibility for defining the scope of their collaboration, although EUREKA has from the outset favoured large targeted projects, such as HDTV, designed to develop a new high-definition

television system, and the Joint European Submicron Silicon Initiative, aimed at moving the European semiconductor industry rapidly to the frontier in semiconductor technology.

61. General assessment of these vast EC-funded research and development programmes holds that the overall effect on the European industry has been positive. Mergers, alliances and other forms of collaboration between firms have been promoted through innovative incentives for joint enterprise programmes.

B. Investment-driven integration: the Asian economic experience

62. The loose form of integration in the Pacific is better described by the concept of cooperation than that of integration; the subregional ASEAN grouping is an exception. But despite the absence of a formal regional integration framework, strong linkages already exist among the countries of the region. 28/ Over the past two decades, the Pacific region countries achieved the highest growth performance in the world, averaging 5.4 per cent yearly even in the adverse period from 1986-1990. Technology transfers are being actively pursued in the region and trade patterns are moving steadily towards greater interdependence. The value of intra-trade of the East-Asian countries in 1990 accounted for more than 40 per cent of their total trade (exports plus imports). 29/

63. The basic mechanism underlying increasing interdependence in the Asia and Pacific region is industrial relocation through foreign direct investment, otherwise known as the flying geese pattern of development, which is characterized by the shift of mature industries from early to late-comer industrializers. Two types of enterprises have been engaged in this process of industrial transfer: local and multinational. The trend is forecasted to continue and the ASEAN countries are expected to receive manufacturing production relocated from Japan and the East-Asian countries and areas (including Taiwan Province of China) to the ASEAN countries and China. Interdependence among countries in the region is expected to increase throughout the 1990s, for the following reasons: (a) the inflow of foreign direct investment to the region is expected to increase; (b) most of the foreign direct investment will come from other Asian countries or areas (Japan, Singapore, the Republic of Korea, Taiwan Province of China and Hong Kong); and (c) much of the offshore production will be directed to serving the South-East Asian regional markets. 30/

64. Industrial relocation involves different levels of technology transfer, not only in standardized mature technologies but also in distinct, complementary and more advanced technologies, particularly in industries such as electronics. The degree and success of technology transfer will in the future depend to a larger extent on the technological absorptive capacity of the host country. Most of the new foreign direct investment that Indonesia, Myanmar, the Philippines, Thailand and Viet Nam may expect to receive in the 1990s may still involve relatively simple labour-intensive technology. However, a radio, a children's toy or a tennis shoe manufactured with the present levels of technological expertise will require higher levels of technical production, worker skill and quality control than those currently existing in the industries established

earlier. Foreign direct investment, however, places a burden on the host country to create the necessary conditions to absorb the new technology introduced by foreign companies and to keep up with changes in its comparative advantage over time.

65. Because of this competitive pressure on their export markets, the economies with great export dynamism in South-East Asia have established institutions which specialize in identifying, assimilating and diffusing technologies. In the ASEAN countries, science and technology have been successfully used as key instruments in order to achieve economic integration. In the area of infrastructure, for instance, the ASEAN programme has already established subregional electric grids and common training facilities aimed at the development of human resources. The ASEAN countries have decided to implement an optical-fibre submarine cable network linking member countries, which is due for completion by mid-1994.

C. Regional integration of developing countries

66. Early attempts at regional integration, including free trade areas, customs unions and common markets, were established among countries in Africa, Latin America, Asia and the Caribbean from the late 1950s until to the early 1970s. These initiatives had two elements in common: first, they were conceived as part of a development strategy based on import substitution and mass production of standardized goods; second, they identified small market size as the principal obstacle to the achievement of scale economies in the production of capital, intermediate and durable consumption goods. The rules of the international trading system, enforced by GATT, obliged these agreements to place intraregional trade liberalization (progressing towards full liberalization) at the heart of the integration process.

67. Voluminous literature exists on the meagre results of developing countries' economic integration efforts. Political, institutional and economic arguments have been assembled to explain the reasons why development goals have been achieved by so few of the integration arrangements. A dearth of political will, lack of appropriate institutions which could direct and coordinate integration and a weak private sector have been identified as the key impediments to the realization of successful regional integration schemes in developing countries.

68. Primarily, benefits of free regional trade arrangements tend to affect economies that already have high levels of trade with one another and whose industrial capacity enables trade creation, such as the shifting of trade from a higher to a lower cost supplier. During the 1960s and 1970s, the industrial capacity of developing countries was limited to the manufactures of unsophisticated finished goods and was highly dependent on extraregional imports for technology, machinery and industrial intermediate goods. Moreover, the stage of industrialization of several developing countries in different regions was very similar, requiring high levels of tariff and non-tariff protection. These factors prevented regional liberalization in manufacturing trade, which would have fostered intraregional trade in industrial goods.

69. A further obstacle to the economic integration of developing countries was encountered in the lack of capabilities of local entrepreneurs, owing to the

absence of experience in external markets. Moreover, the principal objective of foreign-owned firms, mostly United States majority-owned foreign affiliates, was market penetration rather than overseas production for exports. On the export side, a large proportion of the licensing agreements between parent firms and their subsidiaries or between licenser and nationally owned local firms contained export prohibiting clauses. On the import side, regional markets were of too little importance to these subsidiaries, as their parent firm or other firms in the home country would be responsible for all of their imports. The combined effect of such strategies on the part of transnational corporations resulted in market segmentation at the expense of integration and protected regional markets at the expense of liberalization. 31/

70. International liquidity, created by the overall increase of oil prices throughout the 1970s, enabled the deepening of the process of import substitution in some developing countries and the strengthening of their domestic entrepreneurial capacity. Moreover, South-South linkages increased over the period through market-determined trade flows. Evidence exists of a higher skill-intensity of South-South manufactured exports relative to South-North trade in the case of selected exports from Argentina, Brazil, India, Mexico and the Republic of Korea, among others. 32/ It has also been demonstrated that by the end of the 1970s and the beginning of the 1980s developing countries were in a position to transfer technology to other developing countries in terms of both technological services and machinery and intermediate goods. Furthermore, firms from developing countries were engaging themselves in international operations, mostly in other developing countries. 33/

71. Technology had only a small role, if any, to play in the traditional exchange-driven or production specialization integration schemes. Countries first had to build up their domestic technological capabilities in order to cope with the requirements for capital, mass markets and the managerial know-how of the system of mass production for standardized manufactured goods. Such technological capabilities were intended to be established within protected national markets and active industrial policies, but not many countries were able to benefit from dynamic economies of scale and from the associated learning processes (learning-by-doing, learning-by-using and learning-by-interacting).

72. The renewal of the interest of developing countries in integration projects that occurred in the 1980s was the direct result of major changes in the economic environment. In particular, the major actors in the international market-place, the transnational corporations, were articulating the need for a different approach to regional integration. As mentioned previously, they were moving towards the development of competitive advantages based on innovation, quality control and close client-supplier relations. In addition, in order to cope with the rising costs of research and development and to reduce uncertainty without adding to the size of the enterprise, transnational corporations were and are increasingly making use of strategic partnerships in research and development and turning their subsidiaries into independent profit centres. 34/

73. These changes created the basis for a quite different rationale for South-South cooperation, moving away from trade as the unique mechanism for achieving economies of scale and scope towards a more dynamic approach in which knowledge,

linkages and flexible structure came to serve as the fundamental building blocks of competitiveness. The innovation-driven model of South-South cooperation would contribute to the launching of the "virtuous" circle of learning and sustainable technological change.

74. In this context, Brazil and Argentina have signed agreements of technical cooperation in the areas of energy, oil, petrochemicals, informatics and biotechnology. The expansion of these bilateral agreements between the two countries to include Paraguay and Uruguay will constitute the Southern Cone Common Market (MERCOSUR). This progress towards a common market, within the context of open trade policies, is providing incentives for its members to upgrade their industries (including agro-industries) in order to meet regional and international competition. The need to improve their international competitiveness is also motivating larger exporting firms in the area to regional outsourcing, as in the case of one important Brazilian textile enterprise, which signed an agreement with a group of Paraguayan textile firms by which the Brazilian firm would transfer production and managerial technology in exchange for Paraguayan cotton and cotton yarn. Furthermore, several joint-venture agreements have been signed by firms from the four MERCOSUR countries.

75. The Arab countries have also promoted the participation of consulting and contracting firms among themselves in project execution, the employment of expatriate manpower and direct investment in most of their large-scale projects. In 1992, Egypt and Saudi Arabia signed an industrial cooperation agreement which may become a model for similar arrangements between Arab and Islamic countries. There is so far no realistic prospect of Middle East regional integration within the pattern of the European Community. However, more limited moves towards economic cooperation in functional areas such as water management, agreements on the creation of regional infrastructure that will facilitate trade within the region and the creation of regional institutions are envisaged in the near future.

76. In Africa, the unfortunate confluence of poverty, undiversified economic structures and political instability has prevented the realization of new modalities of regional integration. Limitations to the free movements of both labour and capital within various regional groupings, as well as poor telecommunications infrastructure, restrict the participation of African countries in the networking of production and information sharing. Nevertheless, electronic networking holds great promise for reducing the isolation of African scientists and engineers. The African Research Information Network project, for example, was recently established, with the objective of promoting regional electronic networking to enhance the communication capabilities of African research, educational and development communities. 35/

IV. POLICY OPTIONS FOR STRENGTHENING NATIONAL ENTREPRENEURSHIP AND ENDOGENOUS SCIENCE AND TECHNOLOGY CAPABILITY

A. Policy options at the national level

77. For many developing countries, the 1980s have been marked by stabilization policies and drastic reductions in public expenditures, especially in public investment. The adoption of structural reforms have not, however, led developing countries back to the growth rates they had achieved in the past. Moreover, these adjustment policies, with few exceptions, have increased the disparities in national income distribution. The response of local firms to liberal trade regimes and new macroeconomic realities has resulted in higher levels of productivity at the expense of manufacturing employment. Unfortunately, liberal trading policies, permitting cheaper foreign imports, which several developing countries have been implementing since the mid-1980s, are virtually eliminating their less competitive domestic industrial sectors, including those characterized by higher technology content, such as electronics and capital goods.

78. Wide intercountry differences exist among developing countries regarding their capacity to absorb and efficiently use new technologies. There are conflicting views on how to overcome the constraints to their absorptive capacity. The liberal interpretation of recent industrial experience in developing countries argues for reduced government intervention, with a restructuring or privatization of State enterprises and neutral functional policies that could cover a wide spectrum of markets, such as trade and investment liberalization, the promotion of internal competition and the provision of physical and institutional infrastructure.

79. The neo-structuralist interpretation, while accepting the importance of functional policies, argues that the successful experiences of industrialization have been those with strategic State intervention in the process of building up endogenous technological capabilities. Moreover, such interventions embrace both functional policies (strengthening market forces without favouring any particular activity or firm over others) and selective policies (promoting particular activities). Nevertheless, the extent and choice of interventions, as well as the degree of efficiency with which they have been carried out, have varied significantly between countries. 36/

80. The experience of developing countries capable of overcoming their technological backwardness has shown the importance of three main factors actively supported by forward-looking State policies: (a) endogenous capability build-up, particularly manpower development at various levels; (b) accelerated introduction of foreign advanced technologies; (c) stimulation of domestic research and development activities through both institutional and legal factors. 37/

81. The technological dynamism of a country is determined by the ability of its enterprises to master process and product technologies, achieve efficient levels of quality, maintenance and operating procedures, adapt technologies to local materials and customer needs, improve technology over time and diversify, innovate and add to the technological base. Such dynamism is further determined by the capacity of the private sector to establish efficient flows of knowledge

and information with suppliers, customers, consultants and science and technology institutions.

82. The process of training, acquiring new information and engaging in experimentation and interaction with other agents requires effort and investment at all levels of operation. Policy interventions are necessary at three interrelated points: (a) to provide incentive structures that induce enterprises to build up capabilities (sound macro-management policies and provision of selective infant industry protection for activities with high learning costs); (b) to develop responsive capabilities for these incentives (policies to develop the skill base, education and training, aimed at the inducement of technology inflows and the promotion of domestic research and development activity); and (c) to provide a variety of institutions supportive of the functioning of markets (in particular, policies to enhance information-transmission mechanisms, active labour-market policies and policies to promote the development of inter-industry linkages through the establishment of networking programmes). 38/

83. There are several areas which should be covered by national technology systems. Policy instruments should aim at the diffusion of technical innovation within national industrial complexes, assist in the creation of a core of basic generic technologies with multiple industrial applications and develop an adequate infrastructure for establishing technical norms and quality control patterns.

84. Several developing countries have succeeded in establishing effective linkages between national science and technology policies and domestic private and public enterprises. In Latin America, examples can be found of the positive results of local efforts and entrepreneurial capability combined with policy measures.

85. In the case of Brazil, a technology programme was designed through which the State-controlled Brazilian petroleum enterprise Petrobrás achieved world technological leadership in deep-water oil drilling. The State-controlled Telebrás (Brazilian Telecommunications) system established a research and development centre in 1976 to develop technical norms for the Telebrás system and transfer equipment technology developed in-house to domestic equipment suppliers. In the field of agricultural research, the State-controlled agency EMBRAPA has promoted productive interactions between the network of research centres throughout the country and the private sector. 39/

86. Participatory relationships between suppliers and clients and partnerships between firms and universities or research institutions proliferated in Latin America during the 1980s. For instance, the Centro para la Inovación Tecnológica (CIT) was established within the National Autonomous University of Mexico in 1983 with the aim of creating links between the university and the productive sector. By the late 1980s, 12 processes or products developed by CIT were already on the market or in their final production stage. The Centro de Gestión Tecnológica e Informática Industrial in Costa Rica, funded by the United Nations Development Programme and the United Nations Industrial Development Organization, has the express purpose of providing the training, technical information and management consulting needed to stimulate small- and medium-

sized firms to act strategically and to incorporate innovation into their growth strategies. 40/

87. Two other examples can be found in Cuba, which has been able to develop a competitive sector of biotechnology through governmental guidance. The Biological Research Centre developed interferon-based products to fight a broad array of diseases, including those arising from hepatitis B and herpes viruses. The Genetic Engineering and Biotechnology Centre, created in 1985, has developed several high-technology products for the agricultural and animal and human health sectors.

88. Most of the Asian developing countries have systematically pursued the upgrading of their scientific and technological base, investing in human resources and providing linkages between the national research and development systems and the private sector by means of a coordinated industrial policy.

89. Singapore has established science and agro-technology parks to speed up the innovation process and particularly to help small- and medium-sized enterprises to improve their business performance through more effective application of technology. The Institute of Scientific and Technical Information of China plays an important role in providing domestic and foreign firms with consulting services on technical and economic information, as well as acting as a broker for various types of technology transactions. 41/

90. The Republic of Korea has established a set of institutions in order to create the necessary linkages between academia and industry, the traditional and the contemporary, and the domestic and the foreign. First, the Korean Institute of Science and Technology was created as an independent, multidisciplinary industrial research institute for those purposes. Second, the information clearing-house for industrial research was reinforced. Third, quality control and instrument calibration service centres were established as short-term measures in selected areas of industry. As a long-term measure, the Korea Standard Research Institute was reorganized to support industry in this regard. 42/ In addition to the creation of innovation-supporting institutions, particular industries were selected whose technological development was promoted through effective interaction between public and private sectors.

91. In contrast to the above examples, the major systemic constraint to development in most developing countries remains the weak interaction between financial services, educational and manpower policies, investment programmes and technology policies. Furthermore, linkages between the public and private sectors are ill-defined and disjointed.

92. In most regions, developing countries with entrepreneurial capacity and national science and technology institutions are in a better position to transfer technology to other developing countries, either through inter-firm collaborative agreements or through intergovernmental regional and subregional cooperation agreements. In addition, in regions with a lower and less sophisticated entrepreneurial structure, regional and subregional initiatives may be instrumental in pooling together scarce scientific, technological, financial and institutional resources to promote the establishment of the

necessary internal linkages. Regional integration presents a suitable mechanism for the achievement of such efforts.

B. Policy options at the regional and subregional levels

93. Important changes have occurred in the trade policies of developing countries that are leading to higher levels of outsourcing by domestic enterprises, which will result in the expansion of trade. Additionally, the opening up of previously protected markets, as in the case of Latin America, is leading to changes in the strategies of foreign subsidiaries in the region. Open markets in Latin American countries allow for the possibility of productive relocation of foreign subsidiaries to their most efficient operations. This trend towards arms-length operations and externalized production is already evident in the case of Brazil and Mexico, enabling small- and medium-size enterprises to form inter-firm linkages. This type of model of industrial organization leads to increasing specialization of parts and components or subassemblies. In the case of Asian countries, cross-border subcontracting networks which link small- and medium-sized enterprises from different countries to an enlarged network of domestic and foreign firms have become standard practice.

94. Therefore, market and firm-determined intraregional and intraindustrial specialization replaces the industrial specialization brought about by intergovernmental agreements which characterized the regional integration schemes of the 1960s and 1970s. The previous practice of target planning, at the regional and subregional levels, is thus replaced by the creation of innovation networks aimed at the promotion of complementarities between countries through inter-firm collaborative agreements. It is important to recall, however, that initiatives at the regional and subregional levels must recognize the fact that the technological innovation process requires a whole array of non-market services, such as information acquisition and dissemination, training and financial services.

95. The challenges of the technological innovation process are better met through regional arrangements which facilitate access to firms with complementary assets within the region. Hence, it is important to count on mechanisms and instruments of regional reach that favour the access of enterprises from a given country to technological experiences and know-how existing in enterprises and institutions of another country of the region, or alternatively, that favour the establishment of technological development projects among enterprises and research institutions of countries outside the region.

96. The European experience with such innovative programmes as EUREKA and ESPRIT may be an interesting starting point for policy options aimed at the strengthening of entrepreneurship and endogenous scientific and technological capabilities at regional and subregional levels.

97. Regional development banks will play a crucial role in the financing of network systems for linking national systems of science and technology with productive sectors as well as enhancing the regional integration of science and technology. Innovative financial products, such as subsidies, special loans,

risk capital and insurance, are also critical for the creation of incentives, particulary at the early stages of innovation projects.

98. Such regional programmes would encourage cooperation between enterprises, research centres and public and private bodies, and would help to foster a new system of relationships between the scientific, technical and industrial sectors. Their main objectives would be: (a) to improve the quality of products, processes and services in order to open new markets; (b) to attain homogeneous international quality standards; (c) to generate new products, processes and services that are commercially practicable; (d) to establish joint ventures with enterprises and institutions of two or more countries within or outside the region; and (e) to strengthen the productive capacity existing in each country of the region.

99. An example of a creative mechanism for integration along those lines is the Bolívar Programme for Industrial Technological Integration, Innovation and Industrial Competitiveness, financed by the Inter-American Development Bank (IDB). This programme pursues the establishment of institutional and financial mechanisms for the promotion of regional technological cooperation through joint projects, with the active participation of private sector enterprises and research centres. The programme was formally launched in March 1992 with the strong support of Latin American Governments and with technical and financial support from IDB. It has been compared to the European programme EUREKA as a simple and flexible cooperation mechanism for establishing scientific and technological linkages between productive sectors and research centres of Latin America.

100. Another important area for regional cooperation is the establishment of compatible intellectual property rights regimes. Efforts in that direction have already been made in some subregional schemes such as the Andean Group, as well as in the MERCOSUR and the Latin American Economic System. The objective of such regional cooperation is to build on the expertise in intellectual property rights that exists in countries of the region and to promote standards suitable to the development process while complying with international standards. Mechanisms should be created at regional and subregional levels to stimulate the exchange of information among scientists, entrepreneurs and policy makers on the implications of changes in the systems of intellectual property rights for the access of developing countries to new and strategic technologies. Moreover, countries should exchange experiences and knowledge in the management of intellectual property rights, in order to establish a regional system in the area of intellectual property (or patents) that would provide incentives for innovation without limiting the diffusion of innovations throughout the productive apparatus.

101. The growth up of endogenous innovative capability is a long-term process which results in the creation, mastery and use of modern science and technology. Long-term commitments are necessary to establish centres of excellence in universities and research institutes and provide scientific communities with adequate infrastructure, scientific literature and financial resources. Moreover, in the majority of developing countries, long-term investments in human resources, starting with preschool education, are needed in order to break the chain of poverty and technological backwardness.

102. The ultimate objectives of the technological innovation process are to increase the quantity and quality of goods and services available in the economy and to improve the access of the majority of the people to the benefits of technical progress. Growth and social equity are therefore interdependent objectives, and efforts must be made to advance towards these two objectives simultaneously rather than sequentially. 43/

103. There is increasing awareness among countries that the current move towards globalization represents a major reversal in the traditional pattern of industrialization. At present, although transnational corporations represent a large concentration of financial assets in single firms, production has become globally diffused. Information and communications technologies have enabled the concentration of supply while allowing for the increasing tendency to subcontract the production of component parts.

104. In particular, developing countries are concerned about their participation in the new client-supplier relations which have emerged owing to the ongoing interactive process between technological and organizational change.

105. Essentially, regional cooperation and technological innovation are mutually supportive and interdependent processes. Regional and subregional integration can foster technological innovation within the region, and, vice versa, technological innovation can foster regional integration by increasing the scope for internationalized activities.

106. There is much scope for international cooperation at the regional, subregional and interregional levels with a view to increasing efficiency in the use of scarce scientific, technical, entrepreneurial and institutional resources, as well as to promoting inter-firm regional collaborative agreements for improving the international competitiveness of developing economies.

Notes

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2/ Organisation for Economic Cooperation and Development, Economy and Technology (Paris, 1992), chap. 10, pp. 209-236.

3/ See "Substantive theme: impact of new and emerging areas of science and technology on the development of developing countries" (A/CN.11/80, 22 May 1987); Overall Socioeconomic Perspective of the World Economy to the Year 2000 (United Nations publication, Sales No. E.90.II.C.2), chap. VI, pp. 101-131.

4/ See "New developments and trends in the programmes and activities of the United Nations system in science and technology for development" (A/CN.11/1991/5, 14 March 1991).

5/ United Nations Conference on Trade and Development, "Transfer and development of technology in a changing world environment: the challenges of the 1990s" (TD/B/C.6/153, 25 January 1991), pp. 2-5.

6/ As Soete says, more generates more. See Luc Soete, "Opportunities for and limitations to technological leapfrogging", in Technology, Trade Policy and the Uruguay Round (United Nations publication, UNCTAD/ITP/23, 1990), pp. 3-29.

7/ See Advanced Technology Assessment System (ATAS) Bulletin, (United Nations publication, various issues), for further reference.

8/ United Nations Conference on Trade and Development, "Transfer and development of technology ...", chap. II.

9/ Luc Soete, loc. cit., p. 17.

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24/ Paul Rayment, "Comment", Journal of Development Planning, No. 21 (1992), p. 65.

25/ "Europe's technology policy", The Economist, 9 January 1993, p. 19.

26/ The other countries are Austria, Finland, Iceland, Norway, Sweden, Switzerland and Turkey.

27/ Lynn Mytelka, "States, strategic alliances and international oligopolies: the European ESPRIT programme", in Mytelka, ed., op. cit., pp. 181-210.

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ACTIVITIES OF THE UNITED NATIONS SYSTEM: COORDINATION AND COOPERATION IN SCIENCE AND TECHNOLOGY WITHIN THE UNITED NATIONS SYSTEM

Ways and means of improving the quality of coordination and cooperation in science and technology for development

Report of the Secretary-General

SUMMARY

In response to the request of the former Intergovernmental Committee on Science and Technology for Development, the present report provides information on the current situation with regard to coordination, both globally and within the United Nations system, on matters relating to science and technology. Based largely upon recommendation deriving from the meeting of the Administrative Committee on Coordination (ACC) Task Force on Science and Technology for Development, held in December 1992, the report further decribes proposals for enhancing interaction between the Commission on Science and Technology for Development and the specialized agencies, and provides some proposals for strengthening future coordination.

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INTRODUCTION

1. The former Intergovernmental Committee on Science and Technology for Development, in its resolution 1 (XI) B of 3 May 1991, 1/ requested the Secretary-General to submit a report to the Committee at its next session on ways and means of improving the quality of global coordination and cooperation in the area of science and technology for development, as well as system-wide coordination within the United Nations system.

2. The Economic and Social Council has a major mandate for system-wide coordination in the economic, social and related fields 2/ and the Commission on Science and Technology for Development is expected to assist the Council in its central policy coordination functions in the field of science and technology for development within the United Nations system.

3. At the Secretariat level, preliminary ideas for improving system-wide coordination in the field of science and technology were considered by the Administrative Committee on Coordination (ACC) Task Force on Science and Technology for Development at its thirteenth session held in New York in December 1992. At the request of the United Nations Secretariat, contributions to this report were also received from several specialized agencies and other organizations of the United Nations system.

I. BACKGROUND AND CURRENT STATUS OF COORDINATION

4. A report was submitted to the former Intergovernmental Committee on Science and Technology at its eleventh session on "New developments and trends in the programmes and activities of the United Nations system in science and technology for development" (A/CN.11/1991/5). That report, which is available to the Commission, contained information on, and analysis of, relevant activities of 26 organs, organizations and bodies of the United Nations system in three areas, namely, endogenous capacity-building; technology assessment, monitoring and forecasting; and coordination and cooperation at the country level. The recommendations of the report focused, inter alia, on strengthening of field representation in science and technology within the overall efforts being made by the system in that respect, and on the system-wide focal point role of the former Centre for Science and Technology for Development in technology assessment and early identification, analysis and forecasting of global scientific and technological trends.

5. Based on past experience, the main issues relating to past inter-agency coordination efforts, and requiring present attention, may be summarized as follows:

(a) General fragmentation of efforts within the United Nations system;

(b) Lack of regular contacts, and inadequate exchange of information, between the governing bodies of the specialized agencies, and the need to strengthen coordination among Governments' positions vis à vis various United Nations bodies;

(c) Continued need to secure better coordination of the specialized agencies' programmes at national and regional levels;

(d) Absence of a joint United Nations information system in the field of science and technology;

(e) Need to strengthen pre-project analysis work.

6. Greater efforts should be made in examining the specific approaches to coordination and cooperation that the ACC Task Force on Science and Technology for Development has helped to develop over the past 10 years, which include (a) joint activities, (b) policy guidelines, (c) endogenous capacity-building pilot projects, and (d) harmonization at the country level.

7. Joint activities encompass planning and formulation and execution of joint projects based on shared responsibilities and comparative competence. The main difficulty has been in securing the funds for execution, but problems have also arisen in joint administration.

8. Policy guidelines formulated during the period 1987-1988 were to serve as points of reference for individual organizations in designing projects and rendering assistance to member countries. They were to be indicative, and their application was to be left up to the organizations concerned.

9. The ongoing pilot projects undertaken by the Science, Technology, Energy, Environment and National Resources Division of the Department of Economic and Social Development of the United Nations Secretariat on endogenous capacity-building in a number of developing countries originated from discussions by the ACC Task Force on ways to translate the concept of endogenous capacity-building into operational terms. Participation of interested agencies and organizations of the United Nations system in those projects is expected at the final policy dialogue among national stakeholders in each of the countries concerned, when portfolios of prioritized science and technology initiatives are discussed. The involvement of United Nations organizations would also be important in the subsequent implementation of specific programmes and projects, with special emphasis on building of an institutional framework, policy formulation and adjustments, human resources development and technology management. In each country the United Nations Development Programme has been closely involved at every stage of endogenous capacity-building project implementation and could benefit from project results, particularly in relation to country programming exercises.

10. An integral part of the endogenous capacity-building programme that focuses more on the role of the United Nations system as a whole involves the inter-agency missions organized in each of the endogenous capacity-building participating countries. With the aim of better coordination at the country level, such missions assess the effect as well as the effectiveness of United Nations system activities in the field of science and technology in the countries concerned. Several inter-agency missions are planned for 1993. 3/

II. INTERACTION BETWEEN THE COMMISSION ON SCIENCE AND TECHNOLOGY FOR DEVELOPMENT AND THE SPECIALIZED AGENCIES

11. In order for the Commission on Science and Technology for Development to effectively assist the Economic and Social Council in its coordinating role, the ACC Task Force, at its thirteenth session, suggested that the Commission draw from the capital of relevant knowledge and expertise available within the United Nations system as a whole. One way of ensuring this would be through active interaction between the Commission and the specialized agencies.

12. Preliminary ideas for improved interaction about which the ACC Task Force was consulted included the following:

(a) Continuation of the practice of oral reporting by the ACC Task Force Chairman to the Commission at its sessions, followed by an open dialogue;

(b) Active participation of ACC Task Force members in the provision of substantive input for the preparation of reports to the Commission;

(c) Preparation of informal papers on the working modalities of the Commission and submission of proposals regarding possible establishment of committees and working groups of the Commission;

(d) Assistance in the identification of substantive themes;

(e) Organization of preparatory meetings by the regional commissions and/or the specialized agencies prior to each session of the Commission.

13. The ACC Task Force members believed that the programme of activities of the Commission would benefit from more substantive involvement of the regional commissions with regard to the commissions' programmes and responsibility.

III. PROPOSALS FOR FUTURE COORDINATION

A. Greater emphasis on coordination at country and regional levels

14. From a geographical point of view, it is generally understood that inter-agency coordination involves three levels: global, regional and national. Global coordination aims at harmonization of policies, formulation of broad guidelines and criteria for implementation of programmes and activities, and, on occasion, concentration of efforts with respect to identified global priority areas and division of work based on comparative advantages and areas of competence.

15. Coordination and cooperation at the regional level are a primary mandate of the regional commissions. There is an increasing emphasis in this direction, together with the need for improved coordination at the national level. Suggestions made in this connection by the regional commissions include creation of inter-agency task forces among core agencies in each region to help prepare for meetings at the headquarters level of the ACC Task Force proper, for

meetings of the Commission on Science and Technology for Development and for other international science and technology forums.

16. It is the view of the regional commissions that regional differences in local conditions and patterns of economic and technological activity between least developed countries and more advanced developing countries warrant a decentralized, region-by-region approach to any international effort of cooperation in pursuing science and technology for sustainable development. Moreover, the regional commissions, with their geographical proximity to, and vast experience in, working with member States in their respective regions, are better placed to be the prime movers in such a decentralized approach. Involvement of specialized agencies, particularly their regional offices and bureaux, and other regional organizations should be sought in these endeavours, as necessary.

17. Some specialized agencies have expressed the view that country-level coordination is perhaps the most difficult kind of coordination to achieve, because actual activities in science and technology at the national level are essentially the responsibility of each country or institution concerned. It is felt that all too often this difficulty emanates from improper machinery and lack of a firm commitment to use science and technology as a force in development that cuts across sectoral specialization. The United Nations must offer those Governments that desire it a maintenance service in the building of this country-level potential. United Nations cooperation can also be strengthened, particularly in analytical work, at the regional level through its representation on established regional task force mechanisms and at the national level through its establishment of pilot task forces with the representatives of agencies of the United Nations system who are present on the national scene.

18. It was thus suggested by the Food and Agriculture Organization of the United Nations (FAO) that country-level coordination in science and technology for development aimed at endogenous capacity-building could, as appropriate, be carried out by established mechanisms, through, for example, the United Nations resident coordinator or the United Nations Development Programme (UNDP) resident representative in cooperation with country- or regional-level representatives of other United Nations organizations and bodies. Mechanisms such as donors' round-table meetings should be optimized for the purpose of system-wide coordination. The ongoing inter-agency missions have also been conceived as a means to enhance a more harmonized delivery of assistance by the United Nations system in science and technology in a particular country.

B. Reconfirmed focus on national capacity-building

19. As reflected in Agenda 21, 4/ adopted at the United Nations Conference on Environment and Development, held in June 1992 in Rio de Janeiro, the international community has not only renewed but enhanced its awareness of the importance of strengthening endogenous capacities in science and technology as a basis for advancement of developmental efforts and for effective use of technical cooperation. In this respect, the Commission may wish to refer to chapter 34 of Agenda 21, entitled "Transfer of environmentally sound technology, cooperation and capacity-building", and other references found in the

"Compendium of excerpts on science and technology related issues and recommendations", 5/ which is being made available.

20. There is a general agreement among the specialized agencies of the United Nations system that the principal objective of science and technology programmes at the national level should be endogenous capacity-building. System-wide coordination at the country level should be aimed at adopting a coherent approach with a view towards achieving that objective within the context of specific countries with particular sets of development priorities.

C. Harmonization at the headquarters level

21. The United Nations Educational, Scientific and Cultural Organization (UNESCO) expressed the feeling that working-level mechanisms for coordination such as the ACC Task Force on Science and Technology for Development were insufficient, as each of the specialized agencies were bound by their respective governing bodies, which were separate from those of the United Nations proper. The establishment of a mechanism for contacts and coordination among various governing bodies in the field of science and technology would ensure better harmonization at the headquarters level. This could be achieved, for instance, through meetings or teleconferences of heads of science commissions of governing bodies.

D. Coordination on policy studies

22. It is the view of the United Nations University (UNU) that coordination could in principle be facilitated when carried out within a policy studies framework allowing comparative work to be readily organized, but that that should perhaps not be the sole aim of such coordination. Multiple studies are sometimes necessary to bring out a variety of perspectives and recommendations for the benefit of the international community as a whole.

23. However, it is important to ensure that the international community has easy access to the results of various studies in related areas through, for example, a single office of the United Nations system in each country. Establishment of a truly functional data system is regarded by many agencies of the United Nations system as a priority for system-wide coordination. According to FAO, close coordination among United Nations organizations and adequate resources and working relationships with other information sources outside the United Nations system are required in order to reduce to the minimum redundancy and inconsistency of information obtained from various resources.

E. Consultations at the early planning stage

24. The ACC Task Force has emphasized joint planning and programming from the early stages of conceptualization of new activities to enable the relevant United Nations entities to determine the nature and extent of their respective activities and whether the expertise of more than one United Nations entity would be required for a particular activity.

25. The Economic and Social Commission for Asia and the Pacific (ESCAP) has proposed that the integration of coordinated and harmonized activities into the implementation mechanisms of individual entities be reflected in the medium-term plans, programme budgets and activities of funding bodies. Such arrangements require consultations and coordination at the conceptual stage and would result in the highlighting of a selected number of priority activities of developing countries that require joint action and joint financing from both regular and extrabudgetary sources.

F. Focal point for technology assessment

26. Technology assessment is another identified priority area requiring inter-agency cooperation. The General Assembly, in its resolution 44/14 E of 26 October 1989, decided to entrust the former Centre for Science and Technology for Development of the Secretariat, through the Advance Technology Alert System and in cooperation with other United Nations bodies, to serve as the focal point for technological assessment within the United Nations system and, where possible, for relations with Governments and non-governmental organizations concerning technological assessment activities in Member States.

27. The United Nations Expert Group Meeting on Technology Assessment, Monitoring and Forecasting, held at UNESCO headquarters in Paris from 25 to 28 January 1993, provided an opportunity to examine the question of the focal point with the participation of major agencies of the United Nations system as well as experts serving in their individual capacities and with intergovernmental and non-governmental organizations. It made several recommendations regarding the focal point role, including overall coordination and promotion within the United Nations system of activities contributing to strengthening national capacities of Member States for technology assessment, monitoring and forecasting; general support to technology assessment efforts at the national level; establishment of a clearing-house for new ideas, concepts, methodologies and information related to the changing field of technology assessment; and promotion of networking among technology assessment research and practice-oriented institutions.

G. Coordination on identified specific activities

28. It has been found easier and more feasible to foster coordination and cooperation among the various agencies of the United Nations system in relation to specific activities, rather than to try to achieve coordination in broad terms.

29. With this view in mind, the ACC Task Force chose biotechnology and its applications in developing countries as being among the new and emerging areas of science and technology for development for in-depth inter-agency review. After preparing a compendium of United Nations system activities in this field, the ACC Task Force decided to concentrate on the question of the commercialization of biotechnology, with the subject of intellectual property rights as its first consideration. The United Nations Industrial Development Organization (UNIDO) was designated to act as the lead agency and, together with

UNDP and other interested members of the ACC Task Force, to identify possible lines of inter-agency action.

H. Building a United Nations scientific and technological information network

30. There is a strong need for an improved system for regular exchange of science and technology information among organizations and agencies of the United Nations system. Such a system could be initiated at the national level (systems already exist in some countries on an informal basis) to include updated information on past, ongoing and planned projects, rosters of experts and consultants, thematic data, planned monitoring, and evaluation missions of various United Nations system agencies and organizations. The system should be based on a computer network.

IV. UNITY OF PURPOSE

31. The Secretary-General, in his statement to the General Assembly at its forty-seventh session, referred to the objective of the reform exercise as consisting in building a unity of purpose for the economic, social and environmental sectors of the Organization and strengthening linkages between those sectors and the political and humanitarian ones.

32. In 1992, the Administrative Committee on Coordination undertook a comprehensive analysis of its role and functioning as well as a streamlining of its subsidiary machinery. The Administrative Committee on Coordination also established an Inter-agency Committee on Sustainable Development. The Inter-agency Committee consists of a core group of representatives (from UNDP, the International Labour Organisation (ILO), FAO, UNESCO, the World Health Organization (WHO), the World Bank, the World Meteorological Organization (WMO) and the International Atomic Energy Agency (IAEA)), whose initial term is two years, with open-ended membership for other members of the Administrative Committee on Coordination interested in specific issues in the agenda of the Inter-agency Committee on Sustainable Development.

33. The terms of reference of the Inter-agency Committee include the formulation of recommendations for consideration and decision by the Administrative Committee on Coordination that would enhance the effectiveness of cooperation and coordination within the United Nations system.

34. There is increasing recognition that the work of the Administrative Committee on Coordination should be more focused and more action-oriented. As part of the ongoing process of the review of that body's role and functioning and in relation to the restructuring of the intergovernmental machinery, some of the Committee's existing subsidiary bodies might be subject to major reform.

Notes

1/ See Official Records of the General Assembly, Forty-sixth Session, Supplement No. 37 (A/46/37), chap. II.

2/ See annex to General Assembly resolution 45/264 of 13 May 1991 on the restructuring and revitalization of the United Nations in the economic, social and related fields.

3/ Further details on endogenous capacity-building pilot projects and inter-agency missions are contained in the report of the Secretary-General on the assessment of the effect of activities of the United Nations system related to the process of creating and strengthening endogenous capacity-building in science and technology in developing countries (E/CN.16/1993/4).

4/ See Report of the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992, vol. I, Resolutions Adopted by the Conference (A/CONF.151/26/Rev.1).

5/ Extracted from the documents adopted at the United Nations Conference on Environment and Development.

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ACTIVITIES OF THE UNITED NATIONS SYSTEM: ASSESSMENT OF THE EFFECT OF ACTIVITIES OF THE UNITED NATIONS SYSTEM RELATED TO THE PROCESS OF CREATING AND STRENGTHENING ENDOGENOUS CAPACITY-BUILDING IN SCIENCE AND TECHNOLOGY IN DEVELOPING COUNTRIES

Assessment of the effect of activities of the United Nations system related to the process of creating and strengthening endogenous capacity-building in science and technology in developing countries

Report of the Secretary-General

SUMMARY

A major issue in the global economic agenda of the 1990s is ensuring that investment resources are well targeted, coordinated and optimized to yield maximum results. With more claimants than ever before and overall stagnant global investment funds, aid impact and aid coordination have become central concerns.

Recent years have witnessed the renewed directing of attention to the issue of national capacity-building, partly as a reflection of the perception that earlier international policies and efforts did not sufficiently emphasize that issue. The operational activities of the United Nations system, largely as a follow-up to General Assembly resolution 44/211 of 22 December 1989, are attaching considerable importance to the issue, including the modality of national execution. The United Nations Development Programme (UNDP) has launched Capacity 21, a plan of action to assist developing countries in formulating economic, social and environmental programmes and policies on

* E/CN.16/1993/1.

sustainable development, with the aim of strengthening national capacities to integrate and harmonize environment and development and to formulate national capacity-building strategies for implementing Agenda 21. 1/ This programme is supported by a sustainable development network (a UNDP initiative launched in 1990), to make relevant information on sustainable development readily available to developing countries. Many other institutions have also embarked on similar programmes in this area.

In short, the international community and the United Nations system have advanced capacity-building to the forefront of the global agenda, and within their respective mandates individual organizations are attempting to address this crucial dimension of development.

A long-standing concern relates to the means for improving the quality and effectiveness of science and technology activities within the United Nations system. The quantum of resources for science and technology channelled through the United Nations system is difficult to assess, given the different interpretations of what constitutes science and technology, and the nature of activities to be included.

Within the broad scope of science and technology, the activities that can be construed as contributing to endogenous capacity-building are difficult to define. Based on the concept of endogenous capacity-building in science and technology, the following is being sought: to create and strengthen domestic capacities to make the right technological choices in the design and implementation of economic activities, to integrate technological development with macroeconomic management and to put in place the optimum mix of policies and programmes for imparting momentum to this long-term process. As a means of translating that concept into specific action, a pilot programme in 10 developing countries supported through external budgetary resources has been launched and is at various stages of implementation.

An integral part of the pilot programme is an assessment of the impact of the activities of the United Nations system on endogenous capacity-building in a given country. The present report summarizes the conclusions that could be drawn from the assessments made in four countries. A more definitive assessment will be possible in the next six months, following the completion of the pilot projects in six more countries.

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INTRODUCTION

1. The former Intergovernmental Committee on Science and Technology for Development (the predecessor of the Commission on Science and Technology for Development), in its resolution 1 (XI) 2/ adopted on 3 May 1991 at its eleventh session, requested the Secretary-General, in cooperation with the organs, organizations and bodies of the United Nations system, to submit to the Committee, at its next session, an analytical report on how the United Nations system could more actively enhance the impact of its activities related to the process of creating and strengthening endogenous capacity-building in science and technology in developing countries.

2. The General Assembly, in its resolution 46/165 of 19 December 1991, requested the Secretary-General, taking into account the outcome of the United Nations Conference on Environment and Development and on the basis of the discussion by the Intergovernmental Committee on Science and Technology for Development of the substantive theme at its twelfth session, to submit to the General Assembly at its forty-eighth session a comprehensive, analytical report on ways and means of strengthening endogenous capacity-building in science and technology in the developing countries.

3. In its resolution 47/199 of 22 December 1992, the General Assembly requested the Economic and Social Council, through the Commission on Science and Technology for Development at its session in 1993, to consider the note by the Secretary-General (A/47/419/Add.1) on the comprehensive policy review of operational activities of the United Nations system, and to make appropriate recommendations thereon. That note, which examined the contribution of the operational activities of the United Nations system to national capacity-building in science and technology, is submitted to the Commission at its first session as a companion document to the present report.

I. OVERVIEW

4. That development, to be enduring and sustainable, must build on the foundation of human and institutional domestic capabilities to make the right choices, to choose the right priorities and to harness the full potential of local skills, knowledge and resources has emerged as a key concept in the late 1980s, and is now poised at the cutting edge of global change and economic strategic thinking in the 1990s. Capacity 21, a programme launched by the United Nations Development Programme (UNDP) and designed to integrate environment and development and to formulate national capacity-building for Agenda 21, 1/ is an outstanding example of this new thinking and sharpened global consciousness.

5. In no other area, however, is the concept of endogenous capacity-building more relevant and crucial than in that of science and technology. Modern technology, called almost magical, is the essential means through which national comparative advantage (which every country possesses in some form or other) can be transformed into international competitive advantage. Such a transformation cannot take place exclusively through access to external technologies and

injected across the board into economic and industrial activities. More important, effective adaptation and absorption of exogenous technologies cannot be induced without endogenous capacity to decide what to develop domestically, what and how to import, how to diffuse and assimilate and, above all, how to integrate management of technological change into economic policy-making. Clearly, endogenous capacity-building in science and technology is a concept whose time has come, but it is still difficult to operationalize this concept in the country context.

6. The United Nations, primarily the former Centre for Science and Technology for Development and the Department of Economic and Social Development of the United Nations Secretariat, have been grappling with this challenge for over six years. The Centre instituted and backstopped substantive consideration of this theme by the Administrative Committee on Coordination (ACC) Task Force on Science and Technology for Development, by the former Advisory Committee on Science and Technology for Development and by the former Intergovernmental Committee on Science and Technology for Development. Many of the ideas that have now gained respectability and relevance - the programme approach, national execution, participatory priority setting, consensus-building, reliance on local expertise, synergy between domestic and aid resources - have not only been incorporated into the concept but are actually being implemented in a pilot programme in several developing countries. In this sense, the initiative in science and technology is a forerunner of Capacity 21 and other programmes such as the African Capacity Building Foundation of the World Bank. The pilot programme on endogenous capacity-building in science and technology has been widely appreciated and endorsed in broad terms by the Organisation for Economic Cooperation and Development (OECD). It was also reviewed at a meeting of a group of donor agencies that included the International Development Research Centre and the Swedish Agency for Research Cooperation with Developing Countries (SAREC). Although pilot in nature, the programme covers a wide spectrum of countries and the empirical data gathered and the analyses made could provide a conceptual and operational basis, with appropriate adjustments, to other countries and to bilateral donor agencies. The nature and extent of the involvement of the United Nations in those countries need not be as direct and impulsive as in the current programme.

7. The endogenous capacity-building programme in science and technology is an innovative and valuable experiment in the development domain. If successful (and early indications and independent mid-term evaluation results are both encouraging and promising), it could provide useful input into revamping United Nations system operational activities and technical cooperation.

8. An important component of this programme is its review of the impact of external aid, particularly that of the United Nations system as a whole, on endogenous capacity-building, for the purpose of introducing necessary changes in the design, direction and delivery of future projects.

9. A basic study, covering broad assessment and in-depth review of selected case-studies, and an inter-agency mission to the concerned countries, are the means through which this objective is being pursued. Details on the countries visited, the assessments made and the conclusions drawn can be found in the main report. Assessments have been conducted in four countries and six more are scheduled to take place in the autumn of 1993 as an integral input into the

endogenous capacity-building process, thereby paving the way to a more definitive across-the-board assessment of the impact of the activities of the United Nations system.

10. Although the scope of the programme is limited relative to the developing world, it provides a point of reference for making a broader impact assessment of external (especially United Nations system) assistance in science and technology. At a time when many countries are wrestling with other immediate and important problems, involving short- and long-term needs, sustenance and sustainable development and overall stagnant resources for investment, the importance of achieving maximum impact from external aid, especially from multilateral sources, cannot be overemphasized. This is reflected in General Assembly resolution 46/165 on science and technology for development. The subject of science and technology was also considered by the General Assembly in the context of the triennial policy review of the operational activities of the United Nations development system, with the Assembly having requested, in its resolution 47/199, that the Economic and Social Council, through the Commission of Science and Technology for Development at its session in 1993, consider the report by the Secretary-General on the comprehensive policy review of operational activities of the United Nations system as a means to examine the contribution of those activities to the enhancement of the national capacities of developing countries in the field of science and technology. Increased attention to science and technology is also exemplified by the pervasive presence of science and technology issues in Agenda 21, the principal outcome of the Earth Summit and whose implementation is a major challenge to national policy-making bodies and multilateral agencies. As a result, the concept of endogenous capacity-building in science and technology needs to be deepened to include coverage, to a greater degree than before, environmental impact and future assessments.

II. ENDOGENOUS CAPACITY-BUILDING IN SCIENCE AND TECHNOLOGY

11. The United Nations Conference on Science and Technology for Development, 3/ held in 1979 in Vienna, addressed three major issues in science and technology for development, the most fundamental of which was endogenous capacity-building. It had been defined as the extent of local capability to exercise independent, informed judgement and actions regarding the generation, acquisition and development of technologies for economic and social development, including the fulfilment of basic human needs within a society.

12. It should be noted that the concept of endogenous capacity-building in science and technology is not synonymous with indigenous science and/or technology nor is it wholly subsumed under science and technology infrastructure such as research and development institutions. It includes human resource development and the integration of science and technology into macroeconomic policies and is fully in harmony with sustainable development. In its essence, it is the crucial capacity - human and institutional - to decide what science and what technology should be developed domestically, how to obtain access to and negotiate the importation of foreign technologies, and how to harmonize technological change and the growth process, all in the context of long-term development goals and natural comparative advantage. Many developing countries have, at considerable cost, established scientific and technological research

and development institutions, universities, and consultancy organizations, and design and engineering organizations, and have a pool - meagre or large - of scientists and engineers. Many have also formulated, with varying degrees of specificity and success, science and/or technology policies; but in most cases they have remained isolated from overall development and their technological dependency has remained fixed or, at best, has diminished marginally. As aptly stated in a recent OECD report, 4/ "what increasingly defines the less-advanced developing countries is the weakness or even complete absence of a capacity to manage technological change", as a result of which they are confronted with "grave risks of falling further behind more advanced developing countries in their ability to compete in world markets while raising their income levels". The report also states that "it is not building up science and technology per se that is the core issue. What really matters is strengthening - across the whole of society - the capacity to manage technology change ... Against this background, strengthening the national capacity of less-advanced developing countries to manage technological change should be regarded as a critical and urgent development issue for the 1990s."

13. In short, what is being emphasized in the previous paragraph is endogenous scientific and technological capacity, as already described. The important point is that both domestic research, and the obtaining of access to foreign technology on reasonable terms and its assimilation into the economic process, require home-grown capacities to choose, apply and adapt. In reality, domestic research and access to foreign technology constitute two sides of the same coin. Endogenous capacity is crucial for solving pressing development problems such as poverty alleviation and accelerated growth, and for redressing economic and technological dynamics.

14. As complex and crucial as the concept is, it is even more daunting to operationalize and apply it in the sociocultural context of an individual country.

15. The end-of-decade review of the implementation of the Vienna Programme of Action on Science and Technology for Development 5/ emphasized endogenous capacity-building of developing countries in science and technology for development at the country level.

A. Pilot projects

16. Starting in 1986, a series of pilot projects were undertaken in 10 developing countries, at their request, to assist them (in their efforts to accelerate economic growth) in establishing a package of policies and programmes designed to harness the immense potential of modern science-based technologies. The first four countries to participate in those projects were Thailand, Jordan, Nepal and the United Republic of Tanzania, followed by another six developing countries (Cape Verde, Jamaica, Pakistan, Togo, Uganda and Viet Nam) under an interregional project.

17. The primary objective of the programme is to enhance the intrinsic capability of those countries to exercise autonomous and informed judgements on how and where to develop and deploy domestic or external technologies in the fulfilment of their demand-driven developmental priorities. This approach is

consistent with the argument, set forth in paragraph 25 of the note by the Secretary-General (A/47/419/Add.1) on the comprehensive policy review of operational activities of the United Nations system that substantive contributions to endogenous capacity-building by United Nations organizations needed to be made in the context of specific countries or small groups of related countries.

18. The pilot programme, in short, aims to assist interested countries to identify and overcome policy inconsistencies and programmatic gaps in their efforts to harness technology to the service of development.

19. It should be noted that the pilot programme differs significantly from traditional science and technology projects undertaken in developing countries by both bilateral and multilateral agencies. First, it addresses technological dependency from the perspective of macroeconomic management. Second, it develops a people-oriented participatory approach by bringing in a broad range of developmental constituencies and interests that are traditionally left out of prioritizing with respect to science and technology in a country. Third, it places equal emphasis on the process of arriving at a national consensus on prioritization and on the resultant output. Finally, it is demand- and country-driven, thereby reflecting more accurately the country's perceptions and priorities. In short, this programme seeks to strike a balance among policy issues, processes and output, with each element important in its own right, but together constituting a new paradigm.

20. Specifically, this programme aims to achieve the following objectives:

(a) To institute domestic decision-making processes that give due weight to the technological dimension in relation to socio-economic and ecological parameters;

(b) To review and establish organic linkages within the science and technology system and especially among research and development institutes, science and technology information, national research development corporations, and consultancy and design organizations, thereby optimizing human and natural resources in the achievement of clearly defined developmental objectives;

(c) To review economic policies in relation to their impact on endogenous technological development and to integrate scientific and technological activities with fiscal, trade, investment and other macroeconomic policies that are designed to ensure consistency and complementarity;

(d) To build a broad national consensus among the stakeholders in the development process on how and where technologies, domestic or imported, should be targeted so as to make a developmental difference; such a consensus is translated into a portfolio of prioritized policy adjustments and programmes critical to capacity-building;

(e) To assemble a coalition of resources for science and technology drawn from domestic, bilateral and multilateral sources to implement the above-mentioned portfolio.

21. The methodology adopted to achieve the above objectives involves the following:

(a) A preparatory mission from the United Nations to study the country context and to design the specific implementation plan;

(b) Setting up of an organizational structure, including the engagement of a National Project Coordinator and the establishment of a National Steering Committee, usually headed by a high-level government official or prominent personality in the country;

(c) Preparation of diagnostic studies on national technology-sensitive development priorities and needs, and on comparative advantages and constraints of the national science and technology system, as well as on the impact of macroeconomic policies on endogenous capacity-building;

(d) Assessment of the impact of external technology aid projects on endogenous capacity-building through national studies and inter-agency missions;

(e) Organization of a series of national policy dialogues among different stakeholders in the development process leading to the development of a portfolio of priority initiatives, including policies, programmes and projects that provide an organic framework for endogenous capacity-building;

(f) Organization of round-table meetings with the donor community, both bilateral and multilateral, together with the domestic financing institutions, to develop a coalition of resources for the portfolio of initiatives.

22. Appropriate variations have been achieved in each of the six countries for the purpose of taking into account specific situations. Each country participating in the pilot project has set up a National Steering Committee with representatives from the Government, the parliament, industries, academic institutions, the research and development community, the private sector and other interest groups in the country. These are the delegates of the different constituencies and stakeholders in the development process. A National Project Coordinator has also been recruited in each country to organize studies, meetings and dialogues and to serve as the secretary to the National Steering Committee.

23. The first set of substantive studies focused on issues such as the role of science and technology in socio-economic development, the critical review of the legislative framework for science and technology development, inventory of the infrastructure in science and technology and the critical assessment of its utilization for development, the impact of multilateral and bilateral assistance on endogenous capacity-building, and the impact of microeconomic policies on endogenous capacity-building in science and technology.

24. The first policy dialogues in these countries were held in the latter half of 1992. The first dialogues identified issues and recommended further studies with a more sharply focused perspective. The second policy dialogues will be completed by the first half of 1993 (except in Jamaica, which held the second dialogue in December 1992), and the third policy dialogues will be organized in the third quarter of 1993.

B. Inter-agency missions

25. Following the second policy dialogues, when priority issues have been clearly identified and proposals for initiatives have been adequately deliberated by the stakeholders, inter-agency missions composed of representatives of interested agencies of the United Nations system will visit the countries. The impact study on the contribution of external aid to endogenous capacity-building will serve as the basis for the missions. The objective of the missions is to enable representatives of agencies with ongoing or planned activities in science and technology to interact with different constituencies so as to ascertain both their views on how external aid, particularly from the United Nations system, could be made more useful to endogenous capacity-building in science and technology and what changes might be necessary in future activities.

26. Specifically, the inter-agency missions are expected to coordinate the science and technology programmes and projects undertaken by the various agencies of the United Nations system and to review:

(a) The degree to which external support has helped to develop human resources capability to make decisions autonomously as measured with respect to such elements as equipment, fellowships for training nationals, and other training components;

(b) The degree to which outside support fills the gap in the capacity of the institutional framework for science and technology;

(c) The nature and duration of external expert support in the execution of the programme;

(d) The extent to which external support has sensitized national decision makers to the need for strengthening endogenous science and technology capacity through, for example, a commitment of resources;

(e) The use of national endowments such as national resources, consultants and expertise in the execution of projects;

(f) The degree to which activities supported by external sources have continued to be supported through national resources, since the cessation of external support;

(g) System-wide science and technology activities in the countries concerned and the scope for further streamlining and harmonization.

27. The inter-agency missions will also enable the countries concerned to communicate collectively with representatives of the United Nations system and agree on measures to be taken by both the country and the United Nations system in the future. The missions will also interact with bilateral donors so that the overall limited external resources can be channelled to national priority areas. This represents one of the few occasions where the system will act coherently as a catalyst at the country level, and not advocate individual agency interests; and concerned countries have found the approach a welcome relief. The findings and recommendations of the missions will be made available

to the countries concerned and used by the ACC Task Force on Science and Technology for Development and by the United Nations system to make necessary changes, if need be, in the design, context and execution of future activities.

C. Evaluation of pilot projects in participating countries

28. Endogenous capacity, in terms of the making of appropriate decisions in science and technology, cannot be assessed directly. However, it can be examined with regard to performance in the various areas of a country's science and technology structure, policies and programmes.

29. Participating countries differ widely in their social, economic, political and cultural characteristics. Effective evaluation must reflect these factors. Although only a few elements are quantifiable, what finally counts is the impact of the approach on policy and planning, on the nature of the decision-making process, and on human and institutional development. One must assess the effect of the project in initiating and sustaining a process of endogenous capacity-building in science and technology in each country. The ultimate indicator is what happens after United Nations activity is terminated and how far processes, especially policy dialogues, are institutionalized and continued. At this stage, a mid-point evaluation has been initiated that focuses on the following elements:

(a) Establishment of an institutionalized participatory policy-making process in science and technology;

(b) Better coordination in political, economic and social policy frameworks with regard to their impact on science and technology for development;

(c) Enlargement of the national consensus on the priority needs for research and development in the country;

(d) National consensus on the allocation of resources, both internal and external, for the initiatives generated through the policy dialogues as a means to respond to priority development needs;

(e) The quality of the portfolio of initiatives for domestic and external financing, and the degree of success in finding financial resources for it.

30. Two independent evaluators have visited the participating countries to evaluate the work done so far, so that the concerned countries can make assessments and adjustments during the remainder of the project. A review meeting of the Chairmen of the National Steering Committees and the National Project Coordinators was scheduled to be held in Berlin prior to the first session of the Commission. It will take stock of the programme in its entirety in the six countries, using the reports of the evaluators. Representatives of the donor country (Germany) will also be invited to participate.

III. OPERATIONAL ACTIVITIES AND IMPACT ASSESSMENT

31. The United Nations system operates at many levels, and in a diverse range of activities. It is important to note that each organization within the United Nations system also has its own mandate and priorities, and that many organizations have their own governing bodies. Thus, coordination with regard to capacity-building in science and technology at the country level is not always easy. Furthermore, before meaningful coordination can take place, it is necessary to assess the overall impact of the activities of the United Nations system on endogenous capacity-building. The former Intergovernmental Committee on Science and Technology for Development, in its resolution 2 (X), 6/ decided, inter alia, to include an item entitled "Assessment of the impact of the activities of the United Nations system in promoting endogenous capacity-building in developing countries in the field of science and technology" in the agenda of its eleventh session. In response to a request of the Committee set forth in the same resolution, the former Centre for Science and Technology for Development prepared a report (A/CN.11/1991/4) under that item that was submitted to the Committee at its eleventh session. A note by the Secretary-General (A/47/419/Add.1) entitled "Comprehensive policy review of operational activities of the United Nations system" was also issued, under the General Assembly agenda item entitled "Operational activities for development".

32. Impact assessment is an important aspect of the pilot programme on endogenous capacity-building. According to the above-mentioned note by the Secretary-General (para. 35), which was based on the analysis of an external consultant of a comprehensive policy review of operational activities of the United Nations system, that programme constituted one of the few comprehensive evaluations carried out to assess the contributions made by United Nations organizations to capacity-building for science and technology in developing countries.

33. The individual projects have already influenced science and technology policy-setting in the participating countries, and they have led to the starting of a participatory decision-making process, the sensitizing of political leaders and stakeholders in the development process and the critical review of macroeconomic as well as science and technology issues within the framework of each country's development goals and priorities. The process of building endogenous capacity has attracted high-level attention and created a wide impact on society's attitudes towards the role of science and technology in development. Significant progress has also been made towards developing the portfolio of national initiatives. The portfolio is expected to cover three critical areas: (a) measures required to overcome policy inconsistency and impediments to entrepreneurship and productivity, (b) the designing of science and technology infrastructure to contribute decisively to technology-sensitive development priorities and (c) the adding of value to selected national endowments and resources, by focusing on technologies appropriate to the country's specific requirements.

34. Important lessons have been learned with regard to the implementation of programmes of this nature. It is clear that because the projects relied on the guidance of the National Steering Committees and on the expertise of local consultants, achievement of specific goals and targets sometimes took much longer than had been anticipated. Yet this is part of the essential learning

process and should be viewed in terms of its long-term effect. In addition, the development aspect of the projects cannot be overemphasized, especially as in some cases they are still viewed as projects for science and technology per se.

35. The note by the Secretary-General on the comprehensive policy review of operational activities of the United Nations system discussed the methodology of extensive in-country consultations used in the pilot projects in terms of its serving as a means of assisting developing country Governments and the relevant United Nations organizations to reach a consensus on the specific actions needed for endogenous capacity-building in the country concerned. The note suggested (para. 54 (b)) that with some tightening of the methodology used in the initial assessment, which was carried out by each country itself, such an approach seemed to be practical and could be expanded to include the participation of bilateral donors.

36. Once the impact studies, project evaluations and inter-agency missions have been completed in all countries, it should be possible to arrive at a more definitive view, though still on a limited basis, on how far and how much the United Nations system has contributed to endogenous capacity-building in developing countries.

IV. CONCLUSION AND RECOMMENDATIONS

37. The concept and the operational process of endogenous capacity-building are complex and steady efforts are required to understand and sustain both concept and process. The only way a country can learn, however, is through its own learning process. In this sense, the pilot projects on endogenous capacity-building provide the means whereby the country learns to rely on itself and acquires endogenous capacity through a participatory process.

38. The above-mentioned note by the Secretary-General suggested (para. 45) that evaluation was greatly facilitated when, during project design, a series of indicators of success were selected and the best means of quantifying those indicators put in place. It acknowledged that there had been little success to date in the process of developing quantitative indicators of the impact of science and technology on development, mentioned that an extensive discussion of the issue was to be found in a report submitted to the former Advisory Committee on Science and Technology for Development, and proposed that a further review of the status of "impact indicators" would be useful.

39. Based on the findings of the three inter-agency missions conducted so far, the following conclusions can be drawn on the impact of United Nations system activities on endogenous capacity-building:

(a) Although modest in comparison with bilateral aid, technical assistance of the United Nations system in science and technology for development has contributed significantly to overall scientific and technological development;

(b) The concept of endogenous capacity-building in science and technology, though of recent origin, has generated wide consensual support. Existing activities of the United Nations system were not designed to directly achieve

the objective of endogenous capacity and hence are not readily susceptible to an assessment from such a perspective;

(c) A high-level policy decision should be taken in the United Nations to use endogenous capacity-building as one of the major guidelines and yardsticks in the development process; all long-term projects should use endogenous capacity as one of their major objectives, and it should be fully integrated into the project cycle; and decision makers in Member States should be sufficiently sensitized to this concept;

(d) Cross-sectoral projects involving technology input, to the extent possible, should be executed by national organizations, this being an important means of building endogenous capacity in science and technology for development;

(e) There should be prior agreement that projects on endogenous capacity-building, upon conclusion, will be incorporated into national plans and programmes, and effective follow-up measures identified and put in plan before completion;

(f) Greater attention should be bestowed in future on the quality of experts, the timely supply of equipment and services, the training of local personnel, and the adequate modernization and maintenance of equipment;

(g) Bilateral and multilateral donors should harmonize their efforts in science and technology at the country level so as to facilitate greater optimization of collective resources and programmatic complementarity. This should also be coordinated with domestic resources.

40. In its consideration of the present report and of the subject under discussion, the Commission may also wish to refer to the above-mentioned note by the Secretary-General (A/47/419/Add.1), particularly paragraphs 25-54 which address many of the same issues.

Notes

1/ Report of the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992, vol. I, Resolutions Adopted by the Conference (A/CONF.151/26/Rev.1) (United Nations publication, Sales No. E.93.I.8 (Vol. I)), resolution I, annex II.

2/ See Official Records of the General Assembly, Forty-sixth Session, Supplement No. 37 (A/46/37), chap. II.

3/ See Report of the United Nations Conference on Science and Technology for Development, Vienna (20-31 August 1979) (A/CONF.81/16 and Corr.1 and 2) (United Nations publication, Sales No. E.79.I.21).

4/ Organisation for Economic Cooperation and Development (OECD), Managing Technological Change in Less Developed Countries (Paris, OECD, 1991).

Notes (continued)

5/ See Report of the United Nations Conference on Science and Technology for Development, Vienna (20-31 August 1979) (A/CONF.81/16 and Corr.1 and 2) (United Nations publication, Sales No. E.79.I.21), chap. VII.

6/ See Official Records of the General Assembly, Forty-fourth Session, Supplement No. 37 (A/44/37), chap. II.

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ACTIVITIES OF THE UNITED NATIONS SYSTEM: ACTIVITIES OF THE DEPARTMENT OF ECONOMIC AND SOCIAL DEVELOPMENT IN SCIENCE AND TECHNOLOGY FOR DEVELOPMENT

Activities of the Department of Economic and Social Development in science and technology for development

Report of the Secretary-General

SUMMARY

The present report covers the period between the last session of the Intergovernmental Committee on Science and Technology for Development (April 1991) and the first session of the Commission on Science and Technology for Development (April 1993). While it reflects activities carried out under mandates of the former Intergovernmental Committee on Science and Technology for Development, references are made to the results of the United Nations Conference on Environment and Development, held in Brazil in June 1992, which added a new substantive perspective to the concept of technology cooperation between developed and developing countries. The new perspective is also being reflected in a restructuring of the United Nations Secretariat which aims to revitalize its activities in the economic, social and related fields. In the first phase of this process the Science, Technology, Energy, Environment and Natural Resources Division of the Department of Economic and Social Development assumed the responsibilities of the former Centre for Science and Technology for Development. By the time the new Commission on Science and Technology for Development meets for its first session the second phase will have been accomplished, with the creation of the Department for Policy Coordination and Sustainable Development, the Department for Economic and Social Information and Policy Analysis and the Department for Development Support and Management Services to succeed the Department of Economic and Social Development and thus provide a new institutional framework for science and technology.

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INTRODUCTION

1. The role of science and technology in the development process has received new impetus over the past two years, since the Intergovernmental Committee on Science and Technology for Development met for its final session in April 1991. This impetus is due both to changes within the United Nations system which aim to revitalize activities in the economic, social and related fields and to a new role attributed to technology cooperation between developed and developing countries by the United Nations Conference on Environment and Development. These developments brought about a new perspective with regard to activities in science and technology for development:

(a) A more integrated view of science and technology that would lead to an increased cooperation and synergy between activities in the social and economic fields;

(b) A revival of the call of the Vienna Programme of Action on Science and Technology for Development 1/ for technology cooperation, as a result of the 1992 Earth Summit agreements - in particular, elements of Agenda 21; 2/

2. Increased linkages between activities formerly carried out by such diverse bodies as the United Nations Centre for Science and Technology for Development (covering science and technology policy questions), the Department of International Economic and Social Affairs (addressing the overall economic and social context), the Department of Technical Cooperation for Development (in charge of operational activities) and the Centre on Transnational Corporations (representing the private-sector link) were initiated during the first phase of the restructuring efforts through the Department of Economic and Social Development. The second phase reflects deliberations within the Economic and Social Council following the United Nations Conference on Environment and Development, resulting in the creation of three new departments. All of the above programmes have developed over the years with different backgrounds and mandates. Thus, it will be a particular challenge for the new entities succeeding the Department of Economic and Social Development to maintain the high level of synergy and cooperation needed to overcome long histories of fragmentation within the United Nations system. Furthermore, the 1992 Earth Summit added the new paradigm of "sustainability" to the agenda of science and technology as a cross-cutting issue to be reflected in the further implementation of the Vienna Programme of Action. Careful consideration must therefore be given to the outcome of the United Nations Conference on Environment and Development and the role of technology cooperation in the pursuit of sustainable development.

I. BACKGROUND

3. Science and Technology play an important role in the economic and social development of nations. This was realized by the United Nations at an early stage. In 1949 the United Nations Scientific Conference on the Conservation and Utilization of Resources was convened at Lake Success, New York, becoming the first scientific conference organized under the auspices of the United Nations. In the following decade, in 1955, the United Nations Atoms for Peace Conference

was held. Its explicit scientific purpose was to divert nuclear materials to peaceful purposes.

4. The 1960s and 1970s witnessed two landmark conferences specifically dedicated to applying science and technology to the development of developing countries. The United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas, held in Geneva in 1963, sought to demonstrate the means of accelerating development through the application of the latest advances in science and technology. It brought about the conviction that a new and sustained effort by the United Nations was needed to facilitate the transfer of science and technology to developing countries and to help those countries overcome obstacles in access to knowledge and its application. As a result of the Geneva conference, the Economic and Social Council established an Advisory Committee on the Application of Science and Technology for Development. In addition, in 1971, a Committee on Science and Technology for Development was established as a standing committee of the Council.

5. The second major conference in the area of science and technology, the United Nations Conference on Science and Technology for Development, held in Vienna in 1979, reflected discussions during the 1970s on a new economic world order and placed science and technology in the context of international diplomacy. The Vienna conference also represented an awareness that issues of science policy were closely related to questions of economic wealth and to the obstacles faced by developing countries in gaining access to expertise and technology. As a result, new mechanisms were established within the United Nations: a financing system - to become the United Nations Fund for Science and Technology for Development - and the Intergovernmental Committee for Science and Technology for Development. The latter was provided with a secretariat, the Centre for Science and Technology for Development. An Advisory Committee on Science and Technology for Development provided advise on substantive questions related to the implementation of the Vienna Programme of Action in three major areas:

(a) Strengthening the scientific and technological capacities of developing countries;

(b) Restructuring the existing patterns of international scientific and technological relations;

(c) Strengthening the role of the United Nations system in the field of science and technology and the provision of increased financial resources.

6. Within this framework, the Centre - and later its successor, the Science and Technology Branch of the Science, Technology, Energy, Environment and Natural Resources Division of the Department of Economic and Social Development - carried out substantive studies, organized conferences and published reports. Most recently, considerable work has been undertaken in the areas of endogenous capacity-building (with several country projects under way) and technology assessment. Other tasks have included information-related services and the harmonization and coordination of United Nations activities in science and technology through the ACC Task Force on Science and Technology for Development. While the Centre did not have a mandate to operate as an executing

agency, it contributed to the conceptualization of such activities in cooperation with other United Nations bodies such as the Fund.

7. Recent developments have provided a new framework for carrying out science and technology for development within the United Nations. In the spring of 1992, the Secretariat, including its administrative and intergovernmental structure, was reorganized. Science and technology received a broader context within the Science, Technology, Environment, Energy and Natural Resources Division of the Department of Economic and Social Development in the first phase of a series of restructuring efforts. Furthermore, in June 1992, the United Nations Conference on Environment and Development emphasized the need for a new dimension in technology cooperation between developed and developing countries and a stronger emphasis on environmentally sound technologies. The second phase of the restructuring, announced in December 1992, reflected the concerns of the Conference in the establishment of three new departments:

(a) Policy Coordination and Sustainable Development;

(b) Economic and Social Information and Policy Analysis;

(c) Development Support and Management Services.

While these transformations were taking place, activities already initiated under the previous administrative structures were completed or continued, awaiting new guidance from the Commission on Science and Technology for Development. These activities covered endogenous capacity-building and resource mobilization, technology assessment, science and technology information, and harmonization and coordination of science and technology within the United Nations system.

II. SUBPROGRAMMES

A. Endogenous capacity-building and resource mobilization

8. The building of endogenous capacities in science and technology is a crucial factor in determining a nation's ability for economic growth and development and its potential to absorb social, economic or environmental change. This ability requires the existence of institutional, infrastructural and human resources capable of fulfilling basic human needs within a society. Ideally, endogenous capacity-building provides the ability to make informed judgements on matters of science and technology, technology choice, the adaptation and generation of technologies, and, ultimately, the creation of new technologies. The reality in many developing countries often precludes realization of this objective. At the last session of the Intergovernmental Committee, the former Centre reported on projects under way for improving capacities in science and technology in Jordan, Nepal, Thailand and the United Republic of Tanzania. Since 1991, additional projects have been initiated with the Governments of Cape Verde, Jamaica, Pakistan, Togo, Uganda and Viet Nam.

9. Since science and technology are cultural and socio-economic processes, dialogue is at the root of any effective capacity-building. The Centre and its successor within the Department initiated a series of policy dialogues and

specialized expert group meetings in the above-mentioned countries, based on their specific interests. For example, the main objective of the Viet Nam dialogue was to discuss the national situation as the country shifts direction from a centrally planned to a market-oriented economy. Participants in the national dialogue, which was held in June 1992, included scientists, engineers, producers, educators and policy makers. The discussion focused on the role of science and technology in socio-economic development and included a critical review of the existing legislative framework and an infrastructure inventory and assessment. Several initiatives were proposed - among them, the establishment of the Hanoi International Centre for Entrepreneurship, Marketization, Technology Choice and Venture Finance.

10. This general dialogue had been preceded already in December 1991 by a more specialized discussion which focused on the potential of biotechnology in food production in Viet Nam (the results of which are included in issue IX of the ATAS Bulletin). 3/ Researchers representing the field of biotechnology in Viet Nam, individual entrepreneurs and a number of policy makers came together to assess biotechnology in the Vietnamese context. Recommendations were proposed to policy makers, researchers, farmers and commercial enterprises, including a call to strengthen the National Council on Biotechnology, and to establish a Centre for Genetic Engineering and Biotechnology and a National Centre of Excellence. Furthermore, participants recommended a system of quality control and standards, both for domestic production and competitive export products. It was suggested that the research community concentrate, in particular, on complementing traditional approaches in plant breeding and agronomy and on upgrading existing technologies, to carry out in-vitro propagation and micro-propagation of high-value products for the development of virus- and pathogen-free plants of improved quality, and to consider the potential for the production of mushrooms, bio-fertilizers and bio-pesticides.

11. The policy dialogue held in Togo, September 1992, focused on institutional structures, the general direction of scientific research, research areas and intersectoral programmes and specific applications of science and technology in agriculture, engineering, social sciences and human resources. It also analysed requirements such as access to financial resources and university/industry links.

12. A separate and detailed report on the impact of the activities of the United Nations system related to creating and strengthening endogenous capacity-building in science and technology in developing countries is being made available to the Commission during its first session.

B. Technology assessment

13. Technology assessment is a category of policy study that aims to evaluate in broad terms the introduction of new technologies and their effects. It is thus a planning tool for guiding and managing technological change and has been institutionalized in many industrialized and some developing countries through organizations such as the Office of Technology Assessment (United States), the Technology Assessment Office (Germany) or the Technology Information, Forecasting and Assessment Council (India). Other countries are carrying out technology assessment through informal study groups established on an ad hoc

basis between various government agencies, private sector representatives and academics. Within the United Nations system, the General Assembly entrusted the former Centre for Science and Technology for Development in 1989 to serve as the focal point for technology assessment through its Advanced Technology Assessment System (ATAS). By that time, ATAS had already been operating for several years on an experimental basis and had been evaluated by an international expert group.

14. Technology assessment is a dynamic concept that must continually adapt to newly identified problems and emerging technologies. Thus, Agenda 21 specifically calls on the international community, including United Nations agencies, to assist developing countries in building technology assessment capacities for the management of environmentally sound technologies and to strengthen international networking efforts in that context. As a tool for improved technology choice, technology assessment is likely to assist countries' efforts to achieve sustainable development. Yet, most developing countries are still in the process of establishing an adequate infrastructure and an institutional base in terms of science and technology capacities.

15. The Centre and the Science and Technology Branch, through ATAS, carried out studies in different technological areas (biotechnology, micro-electronics, information technology, new materials, energy and environmentally sound technology as well as technology assessment methodology) through ad hoc networks of experts on an international level. The results of these studies have been made available to developing countries. In responding to the need to mobilize technology assessment in the service of sustainable development following the Earth Summit, the Science and Technology Branch assisted initiatives for the establishment of a more continuously operating international network or association through a new global non-governmental organization in technology assessment. A major objective of the organization would be to build a professional technology assessment community through exchange of experiences, expertise and data, along with a particular concern for technology assessment capabilities in developing countries.

1. ATAS publications

16. Since the eleventh session of the former Intergovernmental Committee, four assessment reports have been published in the ATAS Bulletin: "Energy systems, environment and development" (autumn 1991), "Environmentally sound technology for sustainable development" (spring 1992), "Prospects for photovoltaics: commercialization, mass production and application for development" (forthcoming, spring 1993), and "Biotechnology and development: expanding the capacity to produce food" (forthcoming, spring 1993) as described below. 4/

17. Although developing countries account for only 28 per cent of global commercial energy consumption, more than one third of this amount is derived from coal, the production and consumption cycle of which can be a major source of soil, water and air pollution and of greenhouse gases. Furthermore, many developing countries are characterized by a dual energy economy composed of a connected and a disconnected energy sector. The study on energy systems, published by the former Centre, analysed the local demand and supply-side characterization of both sectors as well as technologies for transportation. It

looked at specific case-studies carried out in developing countries and provided planning and policy options.

18. The study on environmentally sound technology is a comprehensive and detailed contribution to the international debate on the role of technology in environment and development. Technology cooperation between developed and developing countries in this area was also one of the issues debated at the United Nations Conference on Environment and Development. The study includes a conceptual framework, an analysis of the technological responses to global environmental concerns, national policies, international cooperation and global prospects.

19. The report on photovoltaics is the result of an international workshop held in Sao Paulo, Brazil, from 16 to 20 September 1991. The 1990s are expected to bring about a strong increase in the sales of photovoltaic systems whose output may range from a few watts to large-scale commercial applications. Mass production of these systems and refinements to the technology will be reflected in continued lower costs. The report examines the state of the art in photovoltaic technologies, with special attention to problems of dissemination and market penetration.

20. Developing countries are rich in genetic resources, and biotechnology offers the potential of exploiting such resources to increase food production, improve the quality of food, adapt crops to harsh environmental conditions and lengthen the "shelf-life" of food through processing technologies. The effect on agriculture is not purely a technical issue, but also involves a broad variety of areas such as conservation of genetic diversity and improved land use and distribution. The ATAS Bulletin of November 1984 (ST/STD/ATAS/1) had already addressed the issue of tissue culture technology and development. The current ATAS project and the Bulletin report on biotechnology involves workshops carried out with local scientists in Africa and Asia and focuses on the role and potential of biotechnology for food production in three specific contexts: national strategies; risk management; and commercialization.

21. Future topics for the ATAS Bulletin are "conversion of military to civilian production" and "remote sensing and development".

22. In addition to the ATAS Bulletin, the Science and Technology Branch continued to publish ATAS News on a quarterly basis as a regular supplement to its newsletter Update. The objectives of ATAS News are to inform scientists and planners of initiatives in technology assessment and forecasting, to serve as an information medium for the networks established by ATAS and to highlight the implications of new technologies in developing countries.

2. ATAS workshops, expert group meetings and conferences

23. In pursuance of the recommendations expressed by a group of independent experts who evaluated ATAS in 1988 at the request of the Intergovernmental Committee, the Committee decided at its tenth session (1989) to assign the Centre (later the Branch) the task of functioning as a focal point for technology assessment within the United Nations system and to carry out technology assessment studies for the General Assembly.

24. In carrying out this mandate, several workshops, expert group meetings and conferences were organized to examine technology assessment methodology and institutionalization as well as more specific assessments of conversion possibilities and clean coal technology.

25. The Centre convened, in cooperation with the Office of Technology Assessment of the United States Congress, the United Nations Workshop on Technology Assessment for Developing Countries, from 4 to 7 November 1991. The workshop brought together about 30 specialists and practitioners from developing and developed countries representing the fields of technology assessment, technology choice and acquisition, planning and decision-making. The workshop highlighted factors relevant to the selection of technologies, capacity-building, experiences through case-studies and networking.

26. New Technologies: Opportunities and Risks for the Environment was the title of an expert group meeting organized by the Centre in cooperation with the Industry and Environment Programme Activity Centre of the United Nations Environment Programme (UNEP), the French Ministry of the Environment and the United States Environmental Protection Agency, held in Geneva, from 13 to 14 January 1992. Although technology assessment has been recognized for many years, environmental effects of new technologies have not been sufficiently assessed. The meeting tried to close some of the existing gaps through case-studies, identification of the essential elements of technology assessment for environmentally sound development and obstacles to an effective use of technology assessment, including a definition of specific areas of need and action.

27. The international expert group meeting on technology assessment, monitoring and forecasting, held in Paris from 25 to 28 January 1993, in cooperation with UNESCO, followed up on the joint meeting with the Office of Technology Assessment with a more comprehensive examination of the methodological issues of introducing technology assessment in a developing country. The meeting discussed economic, social, and environmental impact assessment methodologies and practices and the major factors that are likely to foster technology assessment in the governmental or private sectors. Furthermore, it specified the role that a technology assessment focal point could play within the United Nations system, in implementation of the request of the General Assembly. A detailed report of the meeting will be made available to the Commission.

3. ATAS network development

28. An integrated element of ATAS relates to the building of an international network in technology assessment. In connection with the Paris expert group meeting, a special session of technology assessment institutions took place to discuss the proposal to create a new international non-governmental organization or network in the area of technology assessment. The major task of the network would be to link up developing country institutions to related activities in the industrialized world. The initiative had emerged at the meeting held with the Office of Technology Assessment in Washington in 1991 and had been assisted by the Science and Technology Branch through a global survey of technology assessment institutions and their needs. Furthermore, informal consultations among technology assessment institutions had been held on previous occasions.

Thus, the staff of the Science, Technology, Environment and Natural Resources Division had participated in international forums such as the annual conference of the International Association for Impact Assessment (IAIA), convened at the World Bank in Washington, D.C. (August 1992) and the European Congress on Technology Assessment, held in Copenhagen, Denmark (November 1992) to expand contacts with institutions world wide. The first organizational steps to establish the new non-governmental organization were taken at the special session in Paris.

4. Technology assessment training

29. In cooperation with the International Association for Impact Assessment, the United Nations Fund for Science and Technology for Development and the State Science and Technology Commission of China, the Science and Technology Branch is preparing a training course on technology assessment and management, to be held in Shanghai in June 1993 in conjunction with the annual IAIA conference. The course is aimed at improving the skills of professionals from China, East Asia and South-East Asia in applying technology assessment methodology in decision-making.

5. Other substantive activities assessment

30. Specific applications of technology assessment were the focus of two conference series - on conversion of the military/industrial complex to peaceful uses, and on clean coal technologies - related to the technology assessment subprogramme.

31. The international arms trade today is, according to a study by the Office of Technology Assessment, an international buyers market in which modern tanks, artillery, fighter aircraft, missiles, submarines and other weapons are generally available to any nation that can pay for them. Sellers come from developed and developing countries alike. How can the international community cope with these trends and how can the United Nations translate the favourable political climate following the end of the cold war between East and West into an active policy of disarmament? These were the major questions addressed at the Beijing Conference on International Cooperation in Peaceful Uses of Military/Industrial Technology (22-26 October 1991). The Conference was organized by the China Association for Peaceful Uses of Military Industrial Technologies in cooperation with the former Centre. The shift from military to civilian production is difficult in industrialized and developing countries and most difficult in countries which, under previous policies, have established large-scale military/industrial complexes. International cooperation plays a crucial role in overcoming these problems through research partnerships, arrangements between companies of different countries, and development cooperation.

32. The second conference in the "conversion" series, Conversion: Opportunities for Development and Environment, took place in Dortmund, Germany (24-27 February 1992), in cooperation with the Institute for Environmental Protection and the State Government of Northrhine-Westfalia, the United Nations Secretariat Department for Disarmament Affairs and other United Nations

organizations. Participants addressed the political, economic and legal ramifications of the process of conversion, the role of the United Nations, options for reinvesting a possible "peace dividend" resulting from declining military budgets, and the transfer of technology and know-how to developing countries.

33. The third conference related to conversion took place from 12 to 16 October 1992 in Moscow, with a specific focus on the conversion of the aerospace industry which, in economic terms, is a leading sector of the global defence industry. It is the most advanced technologically and is the major contractor of defence-related research and development. The conference, entitled Technology Assessment in Conversion for Development, was organized jointly by the United Nations and the Government of the Russian Federation.

34. The second conference series, organized by the former Centre and, since the last session of the Intergovernmental Committee, the current Branch, focused on clean coal technology and involved meetings in Beijing (December 1991), Madras (January 1992) and Berlin (May 1992). With China's rapid economic expansion, pollution from coal-burning is unlikely to abate soon, given a lack of resources for an immediate overhaul of the country's energy system. Instead, China will have to rely on a combination of environmental management and rational energy use. India faces similar problems. Clean-coal technologies are needed at all stages of the energy production and consumption cycles, but developing countries and economies in transition will need greatly improved access to environmentally sound alternatives if their contributions of CO_2 to global warming are to be contained. The international round table on environmentally sound coal technologies which concluded the series in Berlin, noted that many developing countries and economies in transition look to coal-fired plants to provide needed electric power and have no short-term alternatives to meet their expanding needs. The Berlin meeting strongly recommended that strategies for reducing greenhouse emissions should be linked to measures that address areas of poverty, population patterns, economic growth and international trade. Furthermore, it was proposed that regional and global clean-coal technology centres be established to focus on technologies and related policies. This conference series also had vital linkages to the activities of the Division's Energy Branch.

35. The Remote Sensing Section of the former Department of Technical Cooperation for Development has become an integral part of the Science and Technology Branch of the Division following the first phase of restructuring. an interregional seminar on remote sensing and the transfer of technology, held in Washington, D.C. (2-14 August 1992), was co-sponsored by the Department and the International Society for Photogrammetry and Remote Sensing. The seminar covered the viewpoints of manufacturers and users of remote-sensing technologies, with a particular focus on technology transfer and the needs of developing countries. Issues addressed included the need to accelerate the transfer of new mapping and remote-sensing technologies, the importance of guidelines for State policies in the science and technology sector, on-the-job training and overseas fellowships, and adequate technology choice.

C. Science and technology information

36. The Science and Technology Branch continues to maintain a registry of national science and technology focal points identified by member States and keeps them regularly informed about science and technology activities within the United Nations system. The Branch also provides them with publications issued by the Division, including the periodic newsletter Update. Update was originally established by the former Centre to provide information on the progress made in implementation of the Vienna Programme of Action on Science and Technology for Development, but publication has taken a broader view of this theme over the past years by reporting on other institutions' activities as well. In the course of restructuring, Update has evolved into a newsletter that represents all of the Division's science- and technology-related activities. It continues to carry the ATAS News technology assessment supplement as a regular feature. It is distributed free of charge to all member States, national focal points and relevant intergovernmental and non-governmental organizations, and to individuals, on request.

37. A proposal by United Nations University (UNU) and the former Centre to establish a United Nations register of research received further study. It was agreed that the register should be implemented by UNU and the Science and Technology Branch in a phased manner to gradually encompass research carried out by the United Nations in science and technology as well as in the political, economic and social fields. The register was intended for the use of the United Nations system, Governments, aid agencies, and other organizations concerned with research policy and planning, and by the international community of scholars and scientists.

38. The Division continued the series of in-house seminars inaugurated by the Centre whereby visitors invited to the United Nations give lectures in their areas of expertise and exchange views with the staff.

D. Harmonization and coordination of science and technology within the United Nations

39. Inter-agency cooperation and coordination has continued through the work of the ACC Task Force on Science and Technology for Development. A Task Force meeting scheduled for the spring of 1992 was postponed to November 1992 in order to allow time for consideration of the outcome of a revitalization of the ACC machinery by the Secretary-General. Furthermore, the new date also provided the opportunity to take into consideration the results of the United Nations Conference on Environment and Development and its implications for science and technology activities within the United Nations system. The Task Force met in November, and a separate report on ways and means of improving the quality of coordination and cooperation in science and technology for development is being provided to the Commission. The future role of the Task Force is under discussion.

E. Substantive themes and expert group meetings

40. The Intergovernmental Committee had proposed that the substantive theme of its next planned session would be the contribution of technologies, including new and emerging ones, for the industrialization of developing countries and for the strengthening of regional and global integration processes, including proposals on ways and means of transferring such technologies and for their incorporation in the productive sector of those countries. Although the Committee has been abolished, the report requested by it has been completed by the Division and is brought to the attention of the Commission at its first session in a separate document.

41. The effect of science and technology on the development prospects of the least developed countries was the focus of the last ad hoc panel/workshop convened by the former Advisory Committee on Science and Technology for Development, in Bujumbura, Burundi, from 4 to 8 May 1992. A separate report from the workshop is available to the Commission.

III. NEW PERSPECTIVES

A. Cooperation and synergy of activities

42. The synergy of activities relevant to science and technology for development within the Department of Economic and Social Development during the first phase of the restructuring of the United Nations in the economic, social and related fields brought together projects that reflected policy studies carried out under the former Centre, social and economic perspective studies under the mandate of the former Department of International Economic and Social Affairs, operational activities through the former Department of Technical Cooperation for Development and specialized studies concerning the role of transnational corporations under the former United Nations Centre on Transnational Corporations. While the major work on science and technology was being carried out by the Science and Technology Branch of the Science, Technology, Environment and Natural Resources Division within the Department, a significant number of activities performed by other units of the Department have programme elements relevant to science and technology.

43. Thus, the former Department of International Economic and Social Affairs assisted developing countries in strengthening their capabilities for processing statistical data through the use of new technologies and enhancing their abilities for developing and maintaining databases. A major document published by the Department, Report on the World Social Situation, addresses science and technology in relation to societal concerns.

44. The former Department of Technical Cooperation for Development had acquired specific competence in carrying out capacity-building operational activities. Its energy, mineral resources, water resources and physical infrastructure units became an integral part of the new Division in the course of the first phase of restructuring, with the addition of a new Environment and Sustainable Development Unit. Together, they cover a wide range of operational activities. Thus, the Mineral Resources Branch assisted the China Geological Institute in establishing a modern system of computerized exploration field data acquisition

and processing by providing hardware, software and training. Furthermore, the Branch convened the Interregional Seminar on Guidelines for the Development of Small/Medium-scale Mining in Harare, Zimbabwe, in February 1993. Its purpose was to produce guidelines for the development of small and medium-scale mining enterprises in developing countries by identifying the parameters and conditions needed to stimulate such development. Some 100 participants were drawn from the policy-making level of ministries of mines from developing countries.

45. A major part of technology transfer world wide is being carried out not by Governments and development cooperation but by transnational corporations and their subsidiaries in developing countries. A report on transnational corporations and economic growth through technology, submitted by the former Centre on Transnational Corporations to the Commission on Transnational Corporations in 1992 (E/C.10/1992/4), highlighted the role of transnational corporations in economic growth and the particular function of technological development in this context, as well as the resulting policy implications.

46. The Long-term Socio-economic Perspectives Branch prepared a report on structural change in the world economy: implications for energy use and air emissions, which provides estimates of energy use during the next three decades on the basis of likely structural and technical changes in the world economy. The projections of energy use made by the study assumed a widening application of existing technologies already used in some countries for the reduction of specific emissions. The Branch intends to prepare a more extensive technical publication on the foregoing topic and to continue to update assumptions about future technology embedded in the United Nations Global Input/Output Model. The model will also be used for the Secretary-General's mid-decade report on the overall socio-economic perspective of the world economy.

47. The Population Division's primary contribution to science and technology is in the area of demography: biennial demographic estimates and projections are prepared for all countries of the world covering the period 1950-2025. Long-range projections are produced on a regional and global basis. The Division also convenes expert group meetings and carries out special studies on issues such as child mortality, AIDS and the interrelationship between population, environment, resources and development. In addition, the Division prepares population databases and computer software for demographic analysis and provides technical support and cooperation to Governments requesting assistance.

48. These activities described above are not an exhaustive account of all science- and technology-related activities carried out by the various components of the Department, but exemplify the complexity of the measures necessary for building science and technology capacities in developing countries.

B. United Nations Conference on Environment and Development, science and technology

49. Principle 9 of the Rio Declaration on Environment and Development, 2/ adopted by the United Nations Conference on Environment and Development, explicitly refers to science and technology:

"States should cooperate to strengthen endogenous capacity-building for sustainable development by improving scientific understanding through exchanges of scientific and technological knowledge, and by enhancing the development, adaptation, diffusion and transfer of technologies, including new and innovative technologies."

50. Furthermore, another document adopted by the Conference, Agenda 21, 2/ contains several references to the role of science and technology in sustainable development. This concerns particularly the access to and transfer of environmentally sound technology, capacity-building for technology management, human resource development, data and information, technology assessment research, and the acquisition, dissemination and generation of environmentally sound technologies.

51. The experiences of the Department that correspond to the recommendations of the Conference in the field of science and technology include the application of technology assessment, support to the development of national strategies and capacity-building for the effective acquisition and adaptation of environmentally sound technologies, and facilitating access to expertise and technology. Thus, the new departmental entities are structured so as to contribute effectively to the implementation of those areas of Agenda 21 that deal with the transfer of environmentally sound technology, science for sustainable development, and national mechanisms and international cooperation for capacity-building.

C. Future directions

52. In pursuance of the "social progress and better standards of life in larger freedom" demanded by the Charter of the United Nations, the United Nations has a role in international science policy, particularly in preventing the world from being divided into areas either connected to or disconnected from the benefits of modern science and technology. Responsibility lies in enhancing the capacities of developing countries in science and technology in every respect, removing obstacles from access to scientific and technological information and providing those countries with the means to manage global environmental change through the acquisition of environmentally sound technologies. The new Commission on Science and Technology for Development faces the challenge of defining the exact role of the United Nations, through the new organizational arrangements within the United Nations Secretariat or other mechanisms, and what it can and should perform. It will be necessary to identify further specific areas where the United Nations as an international organization has a comparative advantage and can play a clear and advantageous role and to identify where its limits lie.

53. Many of the hopes raised by the Vienna Programme of Action, adopted by the United Nations over a decade ago, remain unfulfilled. The United Nations Conference on Environment and Development has revitalized the idea of technology cooperation between developed and developing countries, providing a new impetus to applying science and technology to development. The Vienna Programme of Action, in its preamble, stated that "the necessary resources and technological potentials exist for eliminating the underdevelopment of developing countries

and for improving the well-being of humanity as a whole". 1/ This is even more true today.

Notes

1/ See Report of the United Nations Conference on Science and Technology for Development, Vienna, 20-31 August 1979 (Sales No. E.79.I.21), chap. I.

2/ "Report of the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992" (A/CONF.151/26 (vol. I), chap. I.

3/ United Nations publication, Sales No. E.92.II.A.15.

4/ United Nations publications, Sales Nos. E.91.II.A.4, E.92.II.A.6, E.93.II.A.14 and E.93.II.A.15, respectively.